CHAPTER I

INTRODUCTION

Of the total food production tonnage, 92% comes from plants and the remaining 8% is derived from animal, marine, and single-cell protein source (Borlaug,1992). Increasing interest in using high quality plant foods as replacements to animal source is becoming widespread. Not only are plant sources nutritious, but they are more available and cheaper than animal sources (Hachmeister and Fung,1993).

Studies on legume seed protein span over more than a century; however soybean has been for many decades the only leguminous crop on which significant research has been undertaken. An extremely wide area of use has been developed for this crop in animal feeds, human foods and other industrial applications (Gueguen and Cerletti,1994). There are many types of soy products available throughout the world. Some are produced through the modern processing techniques in large soybean-processing plants such as soybean oil, soymilk, and soymilk products (Circle and Smith,1975; Church,1986). As world populations grow, and as more soybeans are processed, soybean residue will likewise be increased and made available as a source of animal feeds which have a poor protein conversion ratio (Pornthip Charoenthamawat,1991). However, it is still a low cost protein source which we could convert into high nutritive value product.

Tempeh is a traditional Indonesian fermented food in which fungi, particularly *Rhizopus* spp., play an essential role (Nout and Rombouts,1990). The mold fermentation results in a matrix of dense, cottony, mycelia in which cooked soybeans are embedded, forming a compact greyish-white cake. Tempeh possesses a pleasant aroma which can be described as nutty, cheesy, mushroomy, etc. It is free of cholesterol, a good source of vitamins and minerals,

and highly digestible, and is also considered to impart growth-stimulating effects. It can serve as an excellent substitute for animal protein products such as meat, chicken, fish, etc. The high digestibility of tempeh may be ascribed to predigestion of soybean nutrients and their breakdown into soluble solids and nitrogen by the mold during fermentation. The beans, therefore, become soft and tender. The proteases, produced by the mold breakdown protein into amino acids and other waste soluble products which are readily assimilated by the body (Mital and Garg,1990).

In Thailand, we also have fermented soyfood called tooa-nao using as a main dish and a main ingredient in cooking condiments. Tooa-nao is called natto in Japan and kinema in Nepal. This product is made by fermented whole soybeans with *Bacillus subtilis* culture. During fermentation, cooked soybeans bound together and covered with viscous, sticky substance produced by the bacteria, ammonia odor, and nutty flavor (Wang,1984; Reddy, Pierson and Salunkhe,1986). *Bacillus subtilis* is capable of hydrolyzing proteins (Sarkar and Tamang,1995). The proteases produced by *Bacillus subtilis* in kinema might have degraded soy protein which results in the significant increase in non-protein and soluble nitrogen contents. This observation makes the product acceptable and probably contributes to improved digestibility.

During fermentation of tempeh and tooa-nao, protein may be hydrolyzed and solubilised to give products more easily digested than the raw materials. In this study, soybean residues were fermented with *Rhizopus* spp., or *Bacillus subtilis* in order to make soybean residue tempeh or tooa-nao. We propose that these fermentation process will improve the protein quality. Thus soybean residues instead of being discarded or used as low quality animal feed can serve as a source of raw material for making a protein rich food. The purposes of this experiment are as follows;

1. To study and compare the nutritive value of protein in soybean residue before and after fermented with *Rhizopus oligosporus*.

2. To study and compare the nutritive value of protein in soybean residue before and after fermented with *Bacillus subtilis*.