CHAPTER I

Introduction

Deep-fat frying is one of the old and popular process of food preparation. Vast amounts of processed foods are produced by this method because it provides special properties, including flavor and smooth mouthfeel that improve the overall food palatability. One of the most important quality parameters of fried food products is the amount of oil uptake during the frying process which is a key dietary contributor to coronary heart disease and perhaps cancer of the breast, colon and prostate (Saguy and Pinthus, 1995). These negative health symptoms are the main reasons for the need to reduce amount of oil in end products. In order to obtain low fat products, it is essential to understand the mechanisms involved during the process. Deep-fat frying is a complex process that involves simultaneous heat and mass transfer resulting in counterflow of water vapour and oil at the surface of the piece (Bouchon, 2002). The amount of oil taken up by the food is dependent on various factors including frying temperature and time, moisture content, composition, gel strength, porosity and crust (Saguy and Pinthus, 1995; Gamble et al., 1987; McDonough et al., 1993). Although most studies of fried products have been performed in carbohydrate-based products such as potato chips, tortilla chips, and doughnut, there are many fried protein-based product such as meat ball and fried chicken which are popularly and widely consumed. However, compositions of most protein-based products are miscellaneous, and therefore difficult to differentiate the real affecting factors. Nevertheless, fish protein gel or surimi gel which is a unique and homogeneous product can be used as a good protein model for investigation.

Surimi is a heat set gelation product. When minced fish is mixed with salt, the solubilization of the myofibrillar proteins results in formation of a viscous sol. The sol transforms to an elastic and strengthen gel upon heating (Sano et al., 1988; Lanier and Lee, 1992). Generally, surimi gel is formed following heating step which

is preheating below 50°C (setting step) prior to cooking at 80°C or 90°C. The different temperature in the setting step which is important for the conformation of protein provides the final gels with different structure and strengths (Hossain et al., 2001).

Strength of the cooked gel affects structural change, water removal, crust formation and heat transfer during frying. The hardening crust layer seems to be the sheet which prevents the core from contacting directly with hot oil. However, the core can be cooked and steam builds up by conductive heating from the internal interface of the crust which stays at about 100°C (Pedreschi et al., 2001). Variation of the crust strength has effects on steam moving, oil uptake and heat transfer from outside towards the center of the gel during frying.

The frying characteristics and heat transfer inside surimi gel are different from those occur in fried carbohydrate food because of the structure difference. In order to understand this phenomenon, the current work was conducted in three stages. The first stage was the development of surimi gel structure and verification of kinetic model describing the change of gel texture in the form of gel strength. This work was accomplished by microstructural examinations with a solid fraction analysis and scanning electron microscopy (SEM) to indicate the correlation between gel strength and gel texture. This work was aimed at obtaining different surimi gel structures for further study on the frying process. The second stage was frying of the surimi gels to study oil absorption and water removal. The visual analysis using digital camera and SEM was used to reveal the structure change and crust formation of the fried surimi gel. This study was aimed at identifying the main factors that affect oil absorption and the frying characteristics of the gel in order that the mechanistic model could be obtained. Finally, in the last stage of this work, the heat transfer model of surimi gel during frying was developed and compared with the actual experimental data.

Objectives of Research

This research was developed to get better understanding of the mechanism by which the surimi gel is developed during setting and cooking steps and also to get a better understanding of how the oil is absorbed during frying process. This study suggests the importance of the protein gel structure on oil uptake and frying characteristics. Specifically, the following objectives were proposed for this research:

1. Study the effect of setting temperature and time combinations on textural characteristics of surimi gel.

2. Study kinetics of oil penetration during frying of surimi gel, to figure out when, where and how the oil is absorbed by the gel.

3. Develop a mathematical model to describe the heat transfer and temperature distribution inside surimi gel during frying process.