

CHAPTER 1

INTRODUCTION

Oxidative damage or oxidative stresses in the body and in food are caused by free radicals. Free radicals are unstable atoms or groups of atom with unpaired electrons and highly reactive, causing serious damage when they react with important cellular components such as the deoxyribonucleic acid (DNA), or the cell membrane. If uncontrolled, the cells may function poorly or even die. Apart from causing serious damage to the cells and tissues, this reaction can trigger many diseases such as atherosclerosis, coronary heart disease, diabetes, DNA damage, cancer, cirrhosis and degenerative processes associated with aging (Halliwell and Gutteridge, 1984). Although almost all organisms possess antioxidant defense and repair systems that have evolved to protect them against oxidative damage, these systems are insufficient to prevent the damage entirely (Simic, 1988). As such, addition of natural antioxidant supplements, or foods containing antioxidants in the diet, may help the human body reduce oxidative damage and avoids diseases (Sies, 1991).

In food, oxidation may lead to loss of food quality, in terms of its nutritive value, aroma, color, taste and safety. This process is initiated by exposure to the enzyme lipoxygenase, heat, ionizing radiation, light, metal ions and metallo-protein catalysts during food processing. The changes following food deterioration are caused mainly by autoxidation reaction between molecular oxygen and unsaturated lipid and leading to lipid peroxidation. However, once lipid autoxidised in food, it may release toxic products (Kring and Berger, 2001). To prevent oxidative deterioration in food, synthetic antioxidants such as butylated hydroxyanisole (BHA), butylated hydroxytoluene (BHT) and tert-butylated

hydroxyquinone (TBHQ) are used to extend shelf-life of food, reduce wastage and nutritional losses (Shahidi and Wanasundara, 1992). However, BHA and BHT were reported to be carcinogenic (Botterweck *et al.*, 2000). Thus, research on natural antioxidants from natural sources has become increasingly important as a replacement for synthetic antioxidants in reducing oxidation activity in human and food.

The natural antioxidants should have no objectionable flavor, odor or color, effective in low concentration, readily available and economical. Basically it can be said that, the reaction of the best antioxidant must be able to show effects at pathological level, have interactions with enzymes, health implication benefits, stability in the food systems, no carcinogenic potential and is safe to consume (Shahidi and Wanasundara, 1992). Mushrooms were reported to have chemical compounds which exhibit antioxidant properties. In addition, many studies have shown that several types of mushrooms contain beneficial compounds recognized as life-extending material and are effective in treating diseases, for instance, Lingzhi (*Ganoderma lucidum*) has been used for centuries as a cure for cancer, to cleanse toxic deposit from human body, improve the natural healing ability of body and strengthen body's immune system (Yu-Hsiu *et al.*, 2008).

An investigation by Begell (2000) proved that Schizophyllan from *Schizophyllum commune* (cendawan kukur or cendawan kikir) is an important adjuvant treatment for several cancers and useful for recurrent inoperable gastric cancer, as well as increasing survival times of patients with head and neck cancers. While much attention has been drawn to various immunological and anti-cancer properties of these mushrooms, they also offer other potentially important therapeutic properties including antioxidants, anti-hypertensive, cholesterol-lowering, liver protection, anti-fibrotic, anti-inflammatory, anti-diabetic, anti-

viral and anti-microbial (Jong and Donovick, 1989). However, the study of antioxidants derived from *L. squarrosulus* (Mont.) is still relatively rare and no work has been done on the biological properties which may result in the production of new natural antioxidant ingredient for medicine, food, cosmetic and nutraceuticals. Hence, the objectives of the study were:

- I. To optimize the formulation of substrates (maize, soya bean and rice) for solid substrate fermentation (SSF) of *Lentinus squarrosulus* (KUM 50016) for the production of antioxidant extracts.
- II. To compare the antioxidant capacity of extracts obtained via solid substrate fermentation of *Lentinus squarrosulus* (KUM 50016) on optimized substrate formulation and liquid fermentation using DPPH radical scavenging activity.
- III. To determine the lipid peroxidation inhibition activity of selected antioxidant extract obtained by solid substrate fermentation and liquid fermentation using egg yolk and cooking oil.
- IV. To measure total of phenolic content of selected antioxidant extracts obtained by solid substrate fermentation and liquid fermentation using the folin-ciocalteau method.