CHAPTER 1
INTRODUCTION

Mushrooms are fruit bodies of macroscopic, filamentous fungi and they are made up of hyphae which form interwoven web of tissues known as mycelia in the substrate upon which the fungi feed. Collection of food from nature dates back to early history. Even today parallel to food production, people are engaged in collection and discovery of new sources of food. Best of such new sources of food is supposed to be the mushroom which grows naturally on organic and has excellent of taste and nutritional value. Initially mushrooms were collected from nature; however, due to efforts of scientists, it is now possible to cultivate mushroom artificially.

Demand for proteinaceous food is rapidly increasing along with expanding human populations throughout the world. The field of mushrooms has opened up new possibilities of exploring resources of nutritious and delicious food. Edible mushroom is undoubtedly a good source of vegetable protein. Besides, a large number of wild edible mushrooms are also being consumed by the local people and sometimes being exported to other countries.

Mushrooms are rich in protein, minerals and vitamins. However, the awareness of mushroom as a healthy food and as an important source of biological active substances with medicinal value has only recently emerged (Cheung *et al.,* 2003). Mushrooms are considered as healthy food because they are low in calories and fat but rich in proteins and dietary fibers (Manzi *et al*., 1999). The mushroom protein contains all the nine essential amino acids –phenylalanine, histidine, leucine, lysine, arginine, tryptophan, threonine, valine, isoleucine required by humans. In addition to their good protein content, mushrooms are a relatively good source of the nutrients like phosphorus, iron and vitamins, including thiamine, riboflavin, ascorbic acid, ergosterol, and niacin (Barros *et al*., 2008). The moisture content of fresh mushrooms varies within the range of 70-95% depending upon the harvest time and environmental conditions, whereas it is about 10-13% in dried mushrooms. The protein content of the cultivated species ranges from 1.75 to 5.9 % of their fresh weight. Hence mushrooms have been recommended by the FAO as food contributing to the protein nutrition of the developing countries

depending largely on cereals. The digestibility of mushroom protein ranges between 60-70%. Comparatively food value of dry mushroom shows its superiority with other common protein foods.

Mushroom is also an important food item concerning human health, nutrition and disease prevention. Besides the above nutritional aspects, the following medicinal importance of mushroom is noteworthy: (a) Carbohydrates of mushrooms do not contain starch and sucrose and is present in very small quantity, so it is good food for diabetic patients, (b) Many vegetables and cereals are deficient in some of the essential amino acids compared to egg proteins, so it will help in overcoming amino acid deficiency, (c) The mushroom protein is easily digestible and its quality is intermediate between vegetables and meat protein, (d) Mushroom can recover vitamin deficiency (particularly vitamin B) as it is a good source of vitamins.

The Indian subcontinent is known worldwide for its varied agro-climatic zones with a variety of habitats that favour rich mushroom biodiversity (Thakur *et al*, 2011). Mushroom cultivation is the most economical and relatively short biological process for the biotransformation of lognocellulosic materials into protein rich food (Thakur and Singh, 2013; Thakur, 2014). In India, major share (80%) goes to button mushroom production, while rest of the share (20%) goes to tropical mushrooms such as oyster, milky and paddy straw mushrooms. China is the largest producer, consumer and exporter of mushroom in the world followed by USA and Netherland. In North Bengal, the environmental conditions, climate and temperature are very suitable for cultivation of different types of mushrooms all-round the year.

The genus *Pleurotus* (oyster mushroom) comprises some most popular edible mushroom species (*Pleurotus sajor-caju*, *P. ostreatus*, *P. sapidus*, *P. flabellatus*, *P. cystidiosus*, *P. florida*, *P. eous*), due to their favourable organoleptic and medicinal properties as well as vigorous growth. *Pleurotus* species are widely cultivated throughout the world especially in Asia and Europe because of low cost and simple production technology. They have high production and biological efficiency (Khan *et al*, 2014). *Pleurotus* species are rich in carbohydrate, minerals (high in P, K, Ca, Fe, folic acid and low in Na) and fiber as compared to other foods. They are also a rich source of essential and non-essential amino acids such as lysine which is low in cereals. *Pleurotus* species have ability to grow efficiently in a variable range of temperature

conditions (15-30^{0}C), so they can ideally be cultivated throughout the year in different agro ecological zones (Chakraborty *et al*, 2014). Owing to efficient lignin-degraders, it can be cultivated on log and a wide variety of agro-cellulosic wastes, for the production of food, feed, enzymes and medicinal compounds, or for waste degradation and detoxification. Besides, mushroom cultivation a prosperous venture for improvement of livelihood of poor tribal in Tripura have been demonstrated by Biswas *et al*. (2015) and cultivation was optimized in Ethiopia by Tesfaw *et al*. (2015). Abiotic stresses affect the growth and development of organisms both qualitatively and quantitatively. One of the common abiotic stresses is high temperature in growing season. At temperatures over the optimal level for growth, organism usually displays two major damages, oxidative stress and irreversible protein aggregation (Mittler, 2002).

Pleurotus florida has been reported to have antioxidant and antitumor activities (Manpreet *et. al*., 2004), while *P. ostreatus* possess antitumor activity (Yoshioka *et.al.*, 1985). Antihyperglycemic action of oyster mushroom (*P. ostreatus*) has also been demonstrated by Ghaly *et.al* (2011). These medicinal properties might be due to the presence of some important substance in dietary mushrooms. Antimicrobial and antioxidant properties of *Pleurotus ostreatus* cultivated on different tropical woody substrates have been demonstrated (Chaturvedi *et al*, 2011; Saha *et al*, 2012; Oyetayo and Ario, 2013). Chemical analysis of a wild edible mushroom found in the northern tropical moist deciduous forests of Tripura have also been documented (Roy Das *et al*, 2014). Though different types of oral hypoglycemic agents are available along with insulin for the treatment of Diabetes, there is increasing demand by patients to use natural product with antidiabetic activity. Insulin cannot be used orally and continuous use of the synthetic antidiabetic drugs causes side effects and toxicity. The treatment of diabetes often involves medication to control blood glucose levels; some of these medications have undesirable side-effects. Several vegetables have been found to have therapeutic or ameliorating effects in lowering blood glucose levels by reducing insulin resistance and improving glucose tolerance (Yadav *et.al,* 2002). An extensive search for traditional plant treatments for diabetes has concluded that recognized edible mushrooms are an ideal food for the dietetic prevention of hyperglycemia because of their high dietary fiber and protein and low fat content (Alarcon Aguilara *et al.,* 1998). The most common animal models used for the study of the hypoglycemic effects of mushrooms are rats and mice with insulin-dependent diabetes mellitus (IDDM) induced

by Streptozotocin (STZ) and genetically diabetic mice with non-insulin dependent diabetes mellitus (NIDDM) (Beattie *et al.*,1980; Swanston-Flatt *et al.,* 1989).

Keeping in mind the above information about edible mushroom, attempts have been made to develop suitable strategies for improvement in cultivation practices of oyster mushroom in this region, so that the cultivation can easily be continued throughout the year under present changing environmental condition. Its nutrition as well as medicinal values must be retained for the benefit of mankind. In order to full fill the above criteria the present investigation has been undertaken with the following objectives

Objectives

I. Selection of different species of oyster mushroom suitable for cultivation in North Bengal.

II. Molecular characterization of selected *Pleurotus* species

III. Development of cultivation technology of selected *Pleurotus* species with special reference to spawn production, selection and standardization of substrates for higher yield in North Bengal region.

IV. Strategies for management of contaminants during cultivation process.

V. Biochemical characterization and comparison of nutritional value of *Pleurotus* species cultivated in North Bengal.

VI. Evaluation of *in vivo* antidiabetic properties of *Pleurotus* species.

VII. Development of post-harvest technology for better preservation.

VIII. Promotion of mushroom marketing