Chapter 7

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Mushrooms have a notable place in the folklore throughout the world and in the traditions of many cultures. The family of *anodermataceae* consists of a large group of tree fungi of the class *Polyporaceae*, specifically the genus *Ganoderma* and other related genera. *Ganoderma lucidum* is a rare mushroom which was considered precious during ancient times and used in traditional medicine of many countries. Since it was thought as a symbol of immortality, whoever presented it to the kings were rewarded. The spores of this mushroom are very tough and cannot germinate as easily as other mushroom spores. Few countries cultivate this mushroom and utilize it for disease control, because *Ganoderma lucidum* has vast literature evidence for its activity against many diseases, microbes and immunomodulatory functions.

It has become increasingly evident in the recent years that a full spectrum of therapeutic agents for the treatment and prevention of human disease is far from being complete. In an attempt to fill in the gap, drug development research has now focussed on traditional herbal remedies as a potential source for new and more effective medical therapies. Despite considerable progress in the management of Diabetes mellitus by synthetic drugs, the search for indigenous natural anti-diabetic agent is still going on. India being rich in its plant wealth, several plants has been identified as the potential source of drugs in Indian system of Ayurveda medicine for the treatment of diabetes. Even though India is a country with rich biodiversity and ancient therapeutic resources, there is no report for artificial cultivation of *Ganoderma lucidum* collected from Tamilnadu and research on its antidiabetic activity. Because of their diverse activity potential, there is a considerable hope of finding anti-diabetic properties in alloxan/streptozotocin induced diabetic rats.

The present study has focussed on the area of collection of *Ganoderma lucidum* collected from kollihills, Namakkal District of Tamilnadu and standardization of its artificial cultivation method using commonly available substrates. Now a days imported *Ganoderma* powder is available. But they should be paid with high cost that cannot be afforded by common people.

The *Ganoderma lucidum* collected from Kolli hills was identified according to the Simon and Schuster’s Guide to Mushrooms. The were cultivated on 10 different...
substrates readily available in Tamilnadu. They were *Pithecolobium dulce*, Benth, *Eichhornia crassipes*, Solms., *Acacia arabica*, Willd. *Delonix regia* (Borj.ex.Hook) Raf., *Morniga oleifera*, Lam., Saw dust, Rice chaff, Mixer of saw dust and rice chaff, Agro wastes from industry and Paddy straw. Among the ten substrates used as the bed material for the cultivation of *Ganoderma lucidum* the percentage of Food consumption was very high in *Delonix regia* substrate. The mass obtained by the *Ganoderma* in this bed material was also very high when compared to other materials. All the 10 substrates used responded well and it indicates that they all can be used for cultivation depending on the resource available.

The basidiocarps harvested were used for the present study. Water extract was prepared from powdered basidiocarp and it was because of the reason that traditionally *Ganoderma* was consumed as tea and even today *Ganoderma* tea is available in the marker (high cost). STZ induced diabetic rats extract was administered orally for 45 days with the aqueous extract of *Ganoderma lucidum*.

Diabetes mellitus is a silent killer disease that affects more than 151 million people and may attain about five times more subjects in the next 10 years. In the search for new compounds and within exploration of natural resources, the hypoglycaemic effect of plants which are reputed as antidiabetic, the present study is carried out to identify the potent antidiabetic effect of artificially cultivated *Ganoderma lucidum*.

Diabetes mellitus, the most common endocrine disease, is not a single disease but a group of disorders of varying etiology and pathogenesis. It is characterized by abnormal insulin secretion and/or insulin action affecting metabolism of carbohydrates, proteins and fats. Non-insulin-dependent diabetes mellitus (NIDDM), the most common form of the various types of diabetes mellitus, is characterized by chronic hyperglycemia resulting from defects in insulin secretion, with a major contribution from insulin resistance. There is increasing evidence showing that diabetes is associated with increased oxidative stress. Persistent hyperglycemia may cause increased production of free radicals which is related to glucose auto-oxidation that has been linked to non-enzymatic glycation, and glycated proteins have been shown to be a source of free radicals. Since Streptozotocin (STZ) is widely used for...
induction of experimental diabetes mellitus, because of toxic effect to pancreatic β-cells, which is responsible for the secretion of insulin and the excessive production of reactive oxygen species (ROS) including nitric oxide (NO) and subsequent increase of local oxidative stress is suggested as one of the pathophysiological mechanisms of STZ-induced diabetes mellitus. Streptozotocin was selected for the present study to induce diabetes in experimental rats.

Diabetic rats show an increased sensitivity to oxygen free radicals and hydrogen peroxide, the breakdown products of the liver, which induce oxidative stress in diabetes and would damage inner endothelial tissue. This would eventually be directly responsible for high blood glucose. The effect of antioxidants on oxidative stress are measured through certain observable biomarkers. These markers include the enzymatic activities of catalase, SOD, GSH-Px and GSH-reductase, as well as thiobarbituric acid reactants (TBARS) levels and nonenzymatic antioxidants like vitamin C and vitamin E, an indirect measurement of free-radical production that has been shown to be consistently elevated in diabetes.

Diabetes is associated with profound alterations in the plasma lipid, triglycerides and lipoprotein profile and with an increased risk of coronary heart disease. High level of total cholesterol is one of the major factors for coronary heart diseases and it is well known that hyperlipidemia and incidence of atherosclerosis is increased in diabetes. The liver and some tissues participate in the uptake, oxidation and metabolic conversion of free fatty acids, synthesis of cholesterol and phospholipids and secretion of specific classes of plasma lipoprotein. Lipid profile of diabetic rats was in elevated state.

Glucose-6-phosphatase and fructose-1,6-bisphosphatase, key enzymes in the homeostatic regulation of blood glucose concentration, are expressed mainly in the liver and kidney and is critical in providing glucose to other organs during diabetes. The increase of these enzymes can lead to a rise in gluconeogenesis and blood glucose concentration. Reduction of hexokinase activity in the liver and kidney decreases the glucose metabolism and hinders overall glucose homeostasis.

The glycoprotein levels in STZ induced diabetic rats were in elevated level. Glycosylated hemoglobin can be used as an excellent marker of overall glycemic
control. Since it is formed slowly and does not dissociate easily, it reflects the real blood glucose level. Diabetic rats showed higher levels of glycated haemoglobin and decreased total haemoglobin. Reduction in plasma total protein was observed in diabetic rats. Activities of AST, ALT and ACP in plasma is that it may inhibit the liver damage induced by STZ and appears to contribute to alleviating the adverse effect of diabetes mellitus by enhancing lipid metabolism as well as the hepatic antioxidant defense system. The level of Serum enzymes including AST, ALT, LDH, ALP, and ACP show increased activities reflecting active liver damage. In diabetic rats the elevation in plasma bilirubin indicates liver damage as confirmed by the changes in the activities of plasma and liver enzymes. Since STZ selectively damages β-cells of islets of Langerhans resulting in marked decrease in insulin levels, it is rational that glycogen levels in tissues (skeletal muscle and liver) decrease as they depend on insulin influx of glucose.

The oral administration of *Ganoderma lucidum* aqueous extract for 45 days have reverted all the above effects in STZ induced diabetic rats. This report is further supported by histopathological evidence. From these evidences *Ganoderma lucidum* aqueous extract can be suggested as an effective antioxidant, antihyperlipidaemic and antidiabetic agent. Following the method for artificially cultivating *Ganoderma lucidum* even common people can also cultivate and prepare decoction themselves and use it as an effective therapeutic agent against Diabetes mellitus. This study may pave way to open a new area against diabetes in India and the whole World. Since *Ganoderma lucidum* is rich in bioactive ingredients such as triterpenes and polysaccharides further more, comprehensive chemical and pharmacological research can be done to reveal the mechanism of the antidiabetic potential and to identify the active constituent(s) responsible for this effect. Since *Ganoderma lucidum* have potential protective effect against many severe diseases like cancer, allergy, immunodeficiency, cardiovascular, hypertension and so on, the whole extract may be more beneficial than separate constituent. If research support for these information is given in the future, certainly this king mushroom *Ganoderma lucidum* with high potentiality will be a symbol of immortality.

‘Use you food as your medicine and your medicine as your food’- Hippocrates