

Abstracts



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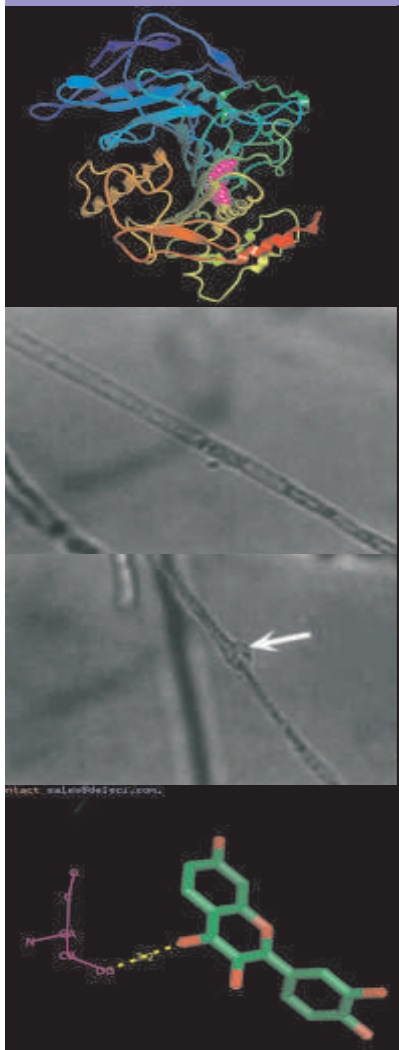
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Leptospira sp. OmPL1 Structural Prediction

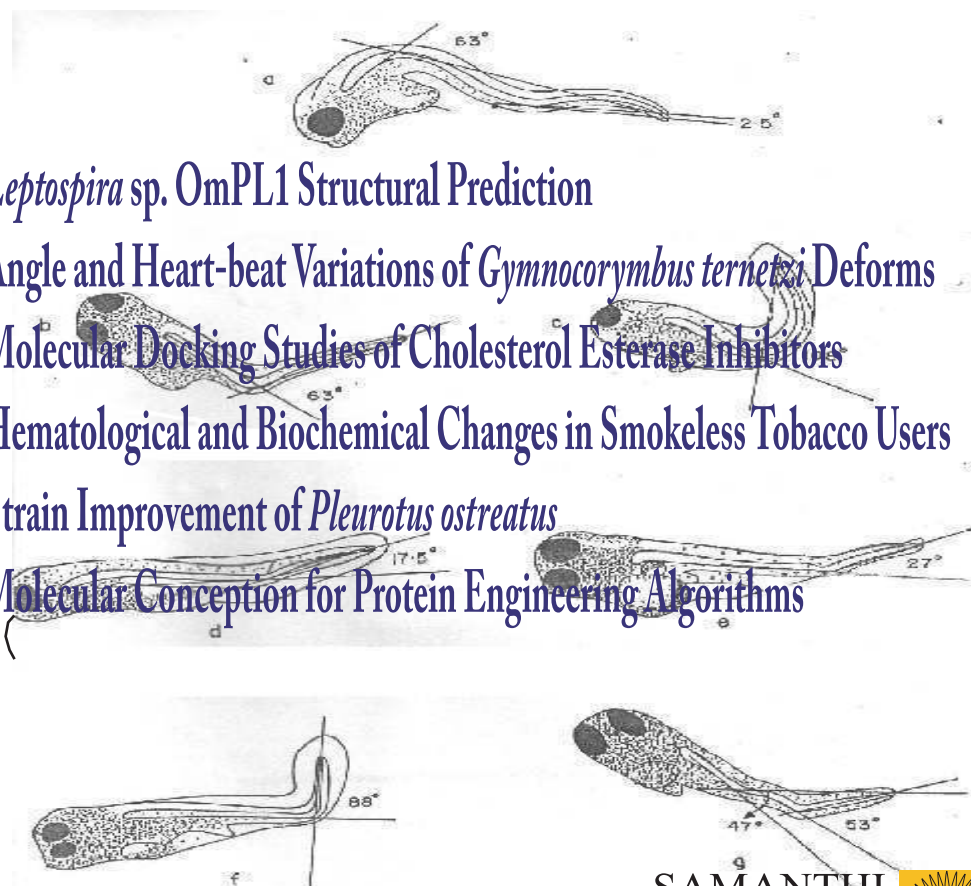
Angle and Heart-beat Variations of *Gymnocorymbus ternetzi* Deforms

Molecular Docking Studies of Cholesterol Esterase Inhibitors

Hematological and Biochemical Changes in Smokeless Tobacco Users

Strain Improvement of *Pleurotus ostreatus*

Molecular Conception for Protein Engineering Algorithms



In vivo Anti-hyperlipidemic Effects of Edible Mushroom, *Agaricus bisporus*

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Abstract

Fungi, *Agaricus bisporus* is a common edible mushroom and ascribed with many therapeutic effects. The aim of the present study was to explore the antihyperlipidemic effects from methanol extract (300 mg/kg body weight) of *A. bisporus*. The methanolic extract of mushroom was ingested by orally to both tested (hyperlipidemic) group of albino rats. The lipid profile and liver enzymes rate were noted. Lipids level shown slight elevation but high density lipoprotein (HDL) had shown opposite effect on treated animals when compared to control. The enzymes, Alanine Transaminase (ALT) and Aspartate Transaminase (AST) rate were declined significantly. The methanol extract of mushroom exhibited more declination effect on lipid profile and liver enzymes level. The protein profile level also showed slightly elevated in the treated rats. The results revealed that the methanolic extract of *Agaricus bisporus* possess higher hypolipidemic activity in albino rat.

Keywords: Mushroom; Pharmacology; Anti-hyperlipidemic; Liver enzymes

Introduction

Now a days, as fat intake in human diet are increasing, the hypolipidemic effect of various types of fruits and vegetables are more and more concerned by people, among them most of the people are using some common edible mushrooms like, *Lentinus edodes* and *Pleurotus ostreatus*. The nutritive value of mushroom generally recorded as non poisonous and commonly they are cultivated and consumed in world wide. They are found to be poor sources of fats and carbohydrates. Appreciable variations were found in the contents of moisture, fibre, ash, protein, non-protein nitrogen, carbohydrate and minerals like calcium, phosphorus and iron. The fresh mushrooms were also found to be good vitamins sources like, Vitamin A and B complex but poor content of vitamins C (Manimegalai *et al.*, 1993). The riboflavin content of mushroom, *Agaricus bisporus* was found to be 0.22 mg/100 g. Most of the mushroom species have high nutritional and medicinal values, particularly the *Auricularia* sp. is popularly known and these are traditional form of food in china recognized for its medicinal value (Yoshida *et al.* 1986). A mushroom possesses potent pharmacological attributes mainly anticancer and pharmacological activities. Besides, mushrooms own significant anti-hypertension, hypocholesterolemic, hepatoprotective and other important medicinal values. Mushrooms are perhaps the only fungi deliberately and knowingly consumed by human beings and they complement and supplement the human diet with various ingredients. Moreover, unique chemical composition makes them suitable for specific groups suffering with certain physiological disorders. As a low calorie high protein item with negligible starch and sugars, these are the delight of the diabetics. Very high potassium and sodium ratio, low calorie and fat, make mushroom the choice of the dietician for those suffering from obesity, hypertension and

atherosclerosis (Chandar *et al.*, 1996). Mushrooms are known to possess the ability to lower blood cholesterol level and certain of them possess pronounced anti-atherogenic properties. Asian have been consuming and using mushroom to alleviate symptoms and to even cure particular ailments for a long time and they have recognized that some fungi like, *Agaricus*, *Reshi*, *Maitake* and *Phollinus* having certain properties that prevent diseases (Royse and Schisler, 1987). Now, many western doctors are beginning to understand and accept the medicinal effects of certain mushrooms. In the recent past, a variety of medicinal preparations in the form of tablet, capsules from mushroom have been produced and marketed. Mushroom with little scope of toxicity and overdoses, do not require very strict regulation and can be sold as the "counter medicine" (Cheng *et al.*, 2002). *Ganoderma lucidum* is the most popular medicinal mushroom in china. Some mushrooms are using for the piles and stomach ache. *Auricularia* sp. for treatment of piles and stomach diseases. *Hericium erinaceus* for gastric ulcers, *Lentinula edodes* for blood pressure and hyperacidity. Some species like, *Ganoderma lucidum* (reishi), *Grifola frondosa* (maitake) and *Auricularia politricha* possessing significant anti-hyperlipidemic, hypoglycemic, hypolipidemic, hypocholesterolemic, hepatoprotective and other important medicinal attributes (Bobek, *et al.*, 1994). However, *Agaricus bisporus* using in traditional form of food but the anti-atherogenic effect is not yet evaluated. The lipids constitute are very important heterogeneous group of organic substances in humans. Lipids are important dietary component and act as fuel in the body. It can be stored in the body in almost unlimited amount in contrast to carbohydrates. Some vitamins like A, D, E, and K are fat soluble, hence lipid is necessary for these vitamins and lipoproteins are the carrier of triglycerides, cholesterol and phospholipids in the body but high content of lipids are very dangerous to human health. The present research was

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focused on the effect of continuous consumption of this edible mushroom on hyperlipidemic rats was carried out.

Materials and Methods

Fresh button mushroom, *Agaricus bisporus* were purchased from local mushroom growers. This kind of mushroom is commonly available all over Tamil Nadu and hill stations. They were cut into small pieces and shade dried for few days and powdered in a stone made mortar and pestle. The finely powdered mushroom materials were packed in a sox let apparatus and extracted with ethyl alcohol and kept cold steeping for 24 hrs. The solvent was evaporated with the help of rotary evaporator. The dried extract was weighed and used to prepare the required volume with coconut oil (300 mg/4 ml). The healthy Albino rats are used as experimental animal. Adult rats of both sexes of 10 weeks-old (weighing about 150–200 g) were selected and segregated in poly propylene cages. Fresh dry husk was used as bed material. They were acclimated to the laboratory condition for a week period prior to the start of the experiments. The animals were maintained with standard nutrients, water and libitum and were used for the study after prior scrutiny and approval from Institutional Animal Ethical Committee (IAEC).

Rats were divided into 3 groups with 6 rats (Group I, II and III) and all group of rats fed with normal rat feed and water. The test group was fed

with High Fat Diet (HFD). The composition of HFD was sucrose (25 g), cholesterol (5 g), yeast (1 g), milk powder (16 g), Bengal gram powder (30 g) and coconut oil (10 ml) and salt mixture (5 g) were mixed and given every day in the form of pellets along with feed for 30 days. Without HFD group was treated as control group. The treatment of the experiment was carried out as follows. Group I: Rats were maintained with only feed, it was treated as control. Group II: Rats were given HFD along with normal feed. Group III: Rats were given HFD with mushroom extract for at the dose level of 300 mg/kg body weight. The experiment was carried for 30 days. After 30 days, rats were killed by cervical dislocation. Liver was excised, washed in ice cold saline and homogenized using Tris buffer (pH 7.6)/ (1 g organ/5 ml buffer) and it was centrifuged at 5000 rpm for 30 min at room temperature. The pellet debris was discarded and supernatant was collected and various biochemical parameters like, total protein, albumin, globulin, cholesterol, triglycerides, Very Low Density Lipoprotein (VLDL), Low Density Lipoprotein (LDL), High Density Lipoprotein (HDL), Glutamine Oxaloacetate Transaminase (GOT), Glutamine Pyruvate Transaminase (GPT), Acid Phosphatase (ACP), Alkaline Phosphatase (ALP) and catalase were analyzed. Results were expressed as *mean* ± *Standard Error (S.E.)* of 6 rats in each group. Students test were used to determine the statistical significance between each control group and its test groups. Significance level (*p*) was fixed at 0.05.

Result and Discussion

The status of total protein, cholesterol, triglycerides and lipid profile levels estimated in the liver of high fat diet induced hyperlipidemic rats. Total protein, albumin, globulin and cholesterol level were found to be moderately elevated in the high fat diet receiving rats (7.9±0.58, and 4.6±0.24) when compared to the control group (4.92±0.38, 2.38±0.32, and 1.70±0.28). In the mushroom extract treated groups only a slight elevation was noted (6.36 ± 0.16, 3.80 ± 0.33, 2.66 ± 0.31) respectively (Table 1). Cholesterol and triglycerides level (128.4 ± 1.03, 272.6 ± 1.22) showed a significant elevation in the rats fed with the high-fat diet when compared to the control group (70.0 ± 1.07, 193.0 ± 1.24). Table (2) The elevation however only moderate in mushroom extract treated groups (107.0 ± 1.26, 227 ± 1.1). Table (3) shows the status of GOT, GPT, ACP, ALP and catalase content in control and high-fat diet induced hyperlipidemic rats. The activity of GOT (4.20 ± 0.19) and GPT (5.84 ± 0.24) shown a steady decrease following mushroom extract treatment, when compared to the control group (3.88 ± 0.20 and 3.74 ± 1.01) and rats fed with high-fat diet (5.78 ± 0.19 and 6.8 ± 0.29). ALP and ACP level were found to be moderately elevated in the high-fat diet receiving rats (10.9 ± 0.8 and 8.23 ± 0.24) when compared to the control group (8.6 ± 0.39 and 5.58 ± 0.15). The mushroom extract treated groups has a significant declination was noted (5.89 ± 0.16, 55.9 ± 0.4). The activity of catalase shown a marked elevation in the rats fed with high-fat diet (43.9 ± 0.29) when compared to the control group (64.0 ± 0.29). In mushroom extract treated group a significant decrease in enzyme level was noted (55.9 ± 0.4). In the present investigation, high fat diet induces hyperlipidemia in experimental animals.

Groups	Protein (g/dl)	Albumin (g/dl)	Globulin (g/dl)	Cholesterol (mg/dl)
GP I (Normal)	4.92 ± 0.38	2.38 ± 0.32	1.70 ± 0.28	70.0 ± 1.07
GP II (hyperlipidemic)	7.9* ± 0.58	4.6* ± 1.14	4.6* ± 0.24	128.4* ± 1.03
GP III (hypolipidemic)	6.36** ± 0.16	3.80** ± 0.33	2.6** ± 0.31	107.0** ± 1.26

Table 1. Elevated significances of protein, albumin, globulin and cholesterol after treatment of mushroom extract

Note: Values are expressed as *mean* ± *S.E.*
 $P < 0.01 = p < 0.05 = \text{Significant}$
 $p < 0.01$ when compared with Group I
 $p < 0.05$ when compared with Group II

Group	Triglycerides (mg/dl)	VLDL (mg/dl)	LDL (mg/dl)	HDL (mg/dl)
GP I (Normal)	193.0 ± 1.24	38.6 ± 0.53	6.8 ± 0.69	24.6 ± 0.85
GP II (hyperlipidemic)	272.6* ± 1.22	54.52* ± 0.57	27.28* ± 0.57	36.6* ± 0.64
GP III (hypolipidemic)	227** ± 1.1	45.4** ± 0.93	25.2** ± 1.17	46.4** ± 0.45

Table 2. Elevated significances of triglycerides, VLDL, LDL and HDL after treatment of mushroom extract

Note: Values are compared as *mean* ± *S.E.*
 $p < 0.01 = p < 0.05 = \text{Significant}$
 $*p < 0.01$ when compared with group I
 $**p < 0.05$ when compared with group II

Group	GOT (IU/L)	GPT (IU/L)	ACP KA Units	ALP KA Units	Catalase
GP I (Normal)	3.88 ± 0.20	3.74 ± 1.01	8.6 ± 0.39	5.58 ± 0.15	6.4 ± 0.29
GP II (hyperlipidemic)	5.78* ± 0.19	6.8* ± 0.29	10.9* ± 0.8	8.23* ± 0.24	43.9* ± 0.29
GP III (hypolipidemic)	4.20** ± 0.19	5.84** ± 0.24	9.6** ± 0.60	5.89** ± 0.16	55.9** ± 0.4

Table 3. Elevated significances of GOT, GPT, ACP, ALP and catalase after treatment of mushroom extract

Note: Values are compared as *mean* ± *S.E.*
 $p < 0.01 = p < 0.05 = \text{Significant}$
 $*p < 0.01$ when compared with group I
 $**p < 0.05$ when compared with group II

High fat diet is a risk factor in atherosclerosis and during an atherogenic process, the production of free radicals increase. Hypercholesterolemia is accepted for development of atherosclerosis Ross (1988). The present observation was coincides with reported by Brown *et al.* (1988). From this investigation, it was well clear that the continuous consumption of this edible mushroom prevents formation of hyperlipidemia. Proteins are the main constituents of cellular organization and its decrease in liver may be due to proteolysis and decreased protein synthesis in the liver. Liver is a chief organ of protein synthesis; even mild lesion may alter its function (Balistreri and Shaw, 1986). It was well documented that elevated total cholesterol and LDL protein cholesterol levels promotes atherosclerosis and cardiovascular complications (Dominiczak, 1998). Elevated triglycerides and cholesterol, especially low density-lipo protein cholesterol (LDL-C) is a major risk factor in development of cardiovascular diseases (Anderson, *et al.*, 1986). It was well known that cholesterol is fatty substance which is important to the membrane of cells in the animal body. Total cholesterol is a measure of total amount of all the cholesterol in blood at a given time and is sum of HDL-C and LDL-C. Triglycerides compose of 3-fatty acid and glycerol. Liking cholesterol they circulate in blood, but are stored in body fat and used when body needs extra energy (Yao *et al.*, 2005). HDL-C removes excess cholesterol from arteries and moves it to liver for further processing or to be eliminated from the body. The HDL-C is "good" cholesterol. It also plays a key role in the protection against oxidative damage of membrane. LDL-C Contributes to build up of fat deposits in the arteries (atherosclerosis), which can cause decreased blood flow and heart attack. So it is always called "bad cholesterol", and a less levels are desirable. In this study TC, TG and LDL-C, HDL-C levels significantly increased in the hyperlipidemic animals fed a high fat diet. All these results showed that the rat hyperlipidemic model was established successfully by feeding high fat diet. After the experiment, the animals administration of mushroom were all exhibited a decrease tendency ($p < 0.05$). Amino transferases (AST, ALT, ALP and ACP) were the more specific markers to identify liver damage. In our observation the enzymes levels were elevated in high fat diet rats. Abnormal activities of alanine transaminase (ALT) and aspartate transaminase (AST) leads to hepatocyte damage (White *et al.*, 1999). The elevated level was maintained in the extract treated hyperlipidemic rats. Therefore it was concluded that the *Agaricus bisporus* mushroom extract has a potential hypolipidemic effect. Efforts should be made to find out the exact compound and its active mechanism which is responsible for the hyperlipidemia and need further investigation.

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