

EFFECTS OF BUTTON MUSHROOM POWDER ON LIPID PEROXIDATION MARKERS IN AN ANIMAL MODEL

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Abstract

Hypercholesterolemia is a major contributor to atherosclerosis and cardiovascular risk. Lower plasma cholesterol levels are associated with reduced incidence of coronary heart disease. Button mushrooms (*Agaricus bisporus*) are rich in nutrients, fiber, and phytonutrients, offering therapeutic benefits including antioxidant, immunomodulatory, cardioprotective, and gut health-promoting effects. This study investigated the potential of button mushroom powder in managing dyslipidemia using a rat model. After analyzing its nutritional composition, 30 rats were divided into three groups: control (normal diet), experimental group I (hyperlipidemic rats treated with 200 mg/kg mushroom powder), and experimental group II (treated with 400 mg/kg). Nutritional analysis revealed that button mushrooms are a good source of protein, fiber, minerals (including magnesium, iron, zinc, and potassium), and have low fat content. Both treatment groups showed a significant reduction in plasma lipid levels and an increase in HDL compared to the control group. These findings suggest that button mushroom powder has a beneficial effect in managing hyperlipidemia.

INTRODUCTION

Hyperlipidemia, a non-communicable disease is characterized by high serum lipid levels which include low-density lipoproteins, cholesterol and triglycerides (1). Hypercholesterolemia is one of the major causes of atherosclerosis. Although there are many causes, hypercholesterolemia is the permissive factor that allows other risk factors to operate. (2) Hyperlipidemia is the leading risk factor for cardiovascular diseases (CVDs) (3). According to the World Health Organization, hypercholesterolemia is responsible for 56% of ischemic heart disease and 18% of cerebrovascular disease globally (4). Coronary heart disease is a leading cause of death in Britain. According to a recent Department of Health survey, the average plasma cholesterol concentration in the UK is 5.9 mmol/l, which is significantly higher than

the 4 mmol/l seen in rural China and Japan.(5) Natural food elements, such as polyphenols, polysaccharides, and bioactive peptides, have demonstrated potential in controlling chronic diseases like diabetes, cardiovascular problems, and obesity by modulating metabolic pathways and lowering inflammation(6). Phytonutrients, which are naturally occurring substances in plants, play an important role in disease prevention and therapy. These bioactive chemicals, such as flavonoids, carotenoids, and polyphenols, have antioxidant, anti-inflammatory, and immune-modulatory activities. Flavonoids, for example, have been proven to impact gut microbiota, which is important in the treatment of inflammatory bowel disease (IBD). Phytonutrients help slow the progression of chronic diseases like

cancer, diabetes, and cardiovascular disorders by lowering oxidative stress and inflammation. (7) Similarly, many studies have been conducted to verify the effectiveness of certain mushrooms that have the tendency to reduce higher levels of lipids. Button mushrooms (*Agaricus bisporus*), which belong to the Agaricaceae family, are well known for their nutritional and medicinal properties. They include bioactive components such as polysaccharides, phenolic acids, and ergothioneine, which aid in their antioxidant and anti-inflammatory activities. (8). These mushrooms are low in calories and fat, but high in dietary fibre, B vitamins, selenium, and potassium, making them an excellent complement to a heart-healthy diet (9). Button name is the Japanese derived and it is also known as black forest mushroom or black oak mushroom (10) which is an edible mushroom that is highly considered therapeutic for its nutritional qualities. Button possesses many protective functions such as it has strong protective role in cardiovascular diseases (CVDs), it also contains hypolipidemic, immunomodulatory, hepatoprotective and anti-viral roles (11). In the treatment of dyslipidemia, button mushrooms have been demonstrated to improve lipid profiles by decreasing total cholesterol, triglycerides, and low-density lipoprotein (LDL) levels while boosting high-density lipoprotein (HDL). Their bioactive chemicals serve to control lipid metabolism and reduce oxidative stress, both of which are important in the prevention of cardiovascular disease. Studies have indicated that including button mushrooms into the diet can promote overall cardiovascular health and help manage dyslipidemia. (12)

Despite the increased interest in natural dietary constituents such as mushrooms for hyperlipidemia treatment, considerable research gaps exist. Mushrooms include bioactive substances such as polysaccharides and β -glucans that can reduce lipid levels, but their exact mechanism of action in human lipid metabolism remains unknown. The majority of studies have been conducted on animal models or in vitro, indicating the need for large-scale, well-designed clinical trials to evaluate efficacy and safety in people.

MATERIALS AND METHODS

Collection and preparation of raw material

Button mushroom was collected from the local area of Punjab and then grind into fine powder and pack in polythene cover to avoid any polythene attach and for further usage.

Chemical composition of button mushroom powder

Proximate analysis

The sample of mushroom powder was investigated for its proximate analysis such as moisture, crude fat, ash, crude fibre and crude protein, which were measured using AOAC (2012) techniques (13).

Minerals determination of Button Mushroom powder

The following minerals sodium, potassium, phosphorous, calcium, magnesium, Selenium, zinc and iron were analyzed by using atomic absorption spectrometry (14).

Phytochemical analysis of Button Mushroom powder

Phytochemical analysis of button mushroom powder investigated for determination of total phenolic content (TPC) and total flavonoids content (TFC). TFC was determined using a colorimetric method as described by (Islam T et al). The TPC was expressed as gallic acid equivalents (mg GAE/g sample) in accordance to standard calibration curve of gallic acid with linear range of 50-500 mg/mL ($R^2 > 0.99$). And TFC was expressed as catechin equivalents (mg CAE/g sample) in accordance to standard calibration curve of catechin with linear range from 10 to 250 mg/mL ($R^2 > 0.99$) (15).

Investigation of Therapeutic potential of button mushroom for the management of hyperlipidemia

The study sought to assess the anti-hyperlipidemic effects of button mushroom (*Agaricus bisporus*) powder on male albino rats. Male albino rats weighing 150-200 grams were obtained from NIH Islamabad and put into three groups. The experimental design allowed researchers to analyze the mushroom powder's lipid-lowering potential by measuring changes in lipid profiles such as cholesterol, triglycerides, and lipoprotein levels. This study emphasizes the

therapeutic potential of button mushrooms as a natural treatment for hyperlipidemia.

Study Duration

The study was conducted for 8 weeks. The trial started in first week of November 2023 and it continued till the last Week of December 2023.

Induction of hyperlipidemia

In the dietary method, rats are fed specially formulated HFD containing high levels of cholesterol,

saturated fats, and sometimes cholic acid for 2 weeks. This diet mimics the lipid profile changes seen in hyperlipidemia, including elevated cholesterol and triglyceride levels. These methods are widely used in research to study lipid metabolism and evaluate potential lipid-lowering therapies. Furthermore, dietary supplements of mushroom powder with 200 and 400 mg doses were administered continuously from week 4 to week 8 after the induction of hypercholesterolemia (16).

Table 1: Treatment Groups And Treatment Plan

Groups	Title	Treatment
G ₀	Control group	No treatment
G ₁	Treatment group 1	Button powder 200mg/kg
G ₂	Treatment group 2	Button powder 400mg/kg

Collection of blood samples

At the beginning and end of the trial blood samples of each rat from the antemedial cubital vein were drawn In sample collecting tubes (17).

Biochemical parameters

All collected samples were analyzed for the lipid profile HDL, LDL, VLDL, TG, cholesterol biomarkers test by using this protocol prescribed by (18)

The obtained data was statistically assessed using SPSS version 20 and reported as means \pm SD. A one-way analysis of variance (ANOVA) was performed to assess significance among the study parameters as indicative of significance ($p < 0.05$), following the guidelines of (19).

Results

Proximate composition

Button mushroom powder contained moisture ($16.5 \pm 0.33\%$), nitrogen free extract ($52 \pm 2.7\%$) ash ($7.96 \pm 0.23\%$), and crude fiber ($12.65 \pm 3\%$) (Crude protein ($17.21 \pm 2\%$) and crude fat ($1.86 \pm 1\%$))

STATISTICAL ANALYSIS

Table 2: Mean \pm S.D for proximate % composition for Button extract on dry weight basis.

Proximate analysis	Composition %
Moisture	($12.5 \pm 0.33\%$)
Ash	($7.92 \pm 0.23\%$)
Crude protein	($17.21 \pm 2\%$)
Crude fibre	($12.65 \pm 3\%$)
Crude fat	($1.86 \pm 1\%$)
Nitrogen free extract	($52.2 \pm 2.7\%$)

Mineral analysis

Button mushroom powder was also analyzed for its mineral that showed the different content of various minerals

Table 3: Minerals in button powder Mushroom

Minerals	Content (mg/100g)
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Copper	8.5±0.02
Zinc	52.4±0.3
Phosphorous	5.54±1.1
Magnesium	1001.2±4.3
Manganese	15.1±0.05
Iron	34.34±0.22
Sodium	64.65±0.02
Potassium	15.76±2.1
Selenium	0.18±0.01
Calcium	245.90±0.07

Phytochemical analysis: Button extract was analyzed for TPC and TFC analysis. The significant amount of TPC and TFC depicted in table 4.

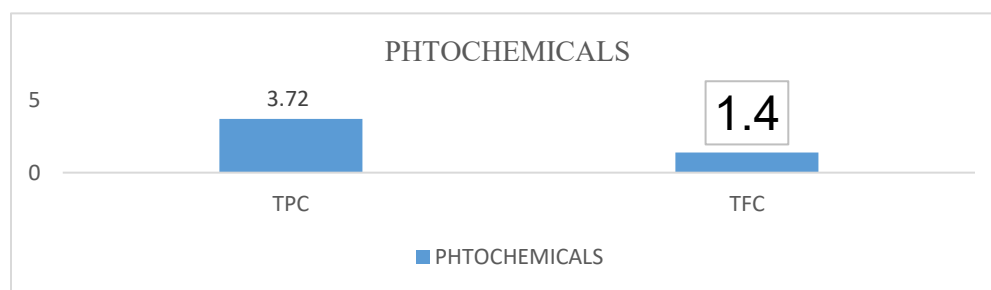


Figure 1 Phytochemical content

Anti-hyperlipidemic potential of button mushroom powder

This study is carried out to investigate the effectiveness of (*Agaricusbisporus*),on hyperlipidemia. For this purpose, male albino rats were studied will be in 3 groups: control group (G₀), treatment group 1

(G₁) and treatment group 2 (G₂). Each group will contain 10 male albino rats. Control group was given with no treatment. G₁ was given with 200mg/kg and G₂ was given with 400mg/kg for 8 weeks. Before and after the treatment period the blood samples were gathered for analysis of lipid profile (HDL, LDL, cholesterol and triglycerides).

Table 5: Mean ± S.D for serum lipid profile levels in rats

parameters	G ₀	G ₁	G ₂
TC	104±5.2	102±3.4	90.3±4.4
TG	62.4±10.2	58±11.3	42.6±0.9
HDL	24.78±1.2	29.21±2.1	35.32±0.2
LDL	16±6.3	15±6.3	13.21±0.9
VLDL	44.31±5.3	32.31±4.4	24.47±4.8
TL	322.73±9	301.90±4.8	255.17±6.8

Discussion

Mushrooms have been increasingly recognized for their potential in managing hyperlipidemia due to their bioactive compounds. Studies have shown that certain edible mushrooms, such as *Agaricus bisporus*

and *Ganoderma applanatum*, exhibit hypolipidemic effects by reducing lipid profiles and improving liver enzyme activity. These effects are attributed to their ability to modulate lipid metabolism, enhance antioxidant activity, and regulate gene expression

related to fatty acid oxidation. Current investigations highlight their role as a natural and effective alternative to synthetic hypolipidemic drugs, with fewer side effects (20)

The results of proximate analysis showed to predict the worth of the raw material being used on being its composition and for the usage of various purposes. Button mushrooms (*Agaricus bisporus*) are highly valued for their nutritional composition, which plays a significant role in their health benefits, including their potential in managing hyperlipidemia. Their proximate composition includes a high moisture content (approximately 90%), making them low in calories. They are rich in proteins carbohydrates and dietary fiber. (21)The mineral composition findings have shown that sodium, zinc, iron, potassium, magnesium are found in greater amounts than others and all these findings are consistent with the previous study on mineral contents of button (22). The phytochemical properties were also investigated that showed that button possess important antioxidant and phytochemical properties. The phytochemicals are phenolic compounds that plays role in prevention of oxidative stress. The findings of TFC and TPC were remarkable and also in-accordance with the previous ones. previous studies have highlighted the therapeutic potential of these phytochemicals. For instance, research has demonstrated that the phenolic content in button mushrooms contributes significantly to their ability to scavenge free radicals and reduce lipid peroxidation. Additionally, ergothioneine has been identified as a potent antioxidant that supports cardiovascular health by mitigating oxidative damage.(23)

The investigation of the dose dependent treatments on the hyperlipidemia rats showed the significant reduction in elevated cholesterol, triglycerides, LDL and VLDL. However, HDL in serum has significantly increased. The reduction in lipid profile in blood is due to the chemical compounds found in button and it's phytochemical and antioxidant potential. These are effective in lowering the oxidative stress and reducing cholesterol and triglycerides and LDL. The increase in HDL showed that button is the contributor to the hypolipidemic effect. Mushrooms' bioactive components have led to increased recognition of their potential in the treatment of hyperlipidaemia (24)Certain edible mushrooms, such

as *Agaricus bisporus* and *Ganoderma applanatum*, have been demonstrated in studies to have hypolipidemic effects by lowering lipid levels and increasing liver enzyme activity. These benefits are attributable to their capacity to alter lipid metabolism, increase antioxidant activity, and regulate gene expression associated with fatty acid oxidation. Current studies emphasize their significance as a natural and effective alternative to synthetic hypolipidemic medications, with fewer adverse effects.(25)

Conclusion

In conclusion, button mushrooms (*Agaricus bisporus*) have tremendous promise as a natural, functional diet in the treatment of hyperlipidaemia. Their nutritional composition, rich in protein and fibre with low fat, and phytochemicals such phenolic compounds, flavonoids, ergothioneine, and β -glucans, contribute to their antioxidant and lipid-lowering properties. By controlling lipid metabolism, decreasing oxidative stress, and altering cholesterol levels, button mushrooms can supplement traditional lipid-lowering medications, providing a dietary-based approach to enhancing cardiovascular health. Continued research and clinical trials are required to confirm their effectiveness and investigate their potential applications in preventative and therapeutic nutrition.

Conflict of Interest:

All the authors have no conflict of interest.

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