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Mushrooms Ability to Deter Diabetes: A Review

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A B S T R A C T

For its potential as a supplement to conventional drugs and therapies, mushrooms have been the subject of substantial medical investigation. Many in vitro and in vivo studies using animal and human models have demonstrated that the polysaccharides, oligosaccharides, dietary fibres, peptides, amino acids, fatty acids, micronutrients, and phenolic bioactives present in mushrooms impart a wide range of medical and therapeutic approaches properties. These components, either individually or together, follow complex routes to display biological and functional activity. These higher classes of fungi have a range of medicinal properties, including antioxidant potential, anti-inflammatory action, and anti-aging, as a result of their high fibre and polysaccharide content. Several dietary fibres and saccharides have immunosuppression, anti-diabetic, anti-hypertensive, and anti-hyperlipidemic properties. Terpenoids and phenolic compounds in the mushroom are responsible for its protective benefits on the heart, liver, neurons, kidneys, and liver. Among other anti-diabetic mushrooms are Pleurotusostreatus, Ganodermalucidum, Grifolafrondosa, and Lentinusedodes. In addition to reducing cholesterol production and absorption, mushrooms also reduce food consumption, promoting a healthy gastrointestinal system, and promote healthier. We compiled the most recent research on the benefits of consuming edible mushrooms for your health in this article. So, it can be concluded that regularly including mushrooms in your diet may aid in the prevention of diabetes.

Keywords: Diabetes, Mushroom, Bioactive compound, Cholesterol

1. INTRODUCTION

The words "diabetes mellitus" and "DM" are inspired by the Latin "mellitus," which means sweet, and the Greek "diabetes," which means syphon or to pass through. Diabetes mellitus is a set of non-communicable metabolic illnesses characterised by chronic hyperglycemia brought on by abnormalities in insulin production, insulin action, or both [1]. Diabetes mellitus is a long-term metabolic condition characterised by irregular insulin production and insensitivity to the role of this hormone in transmitting signals from cellular receptors. excessively high plasma glucose levels are the outcome. As a result of these metabolic modifications, the metabolism of proteins, lipids, and carbohydrates has also been altered. The primary cause of most type 2 diabetes problems in people is hyperglycemia [2]. According to the American Diabetes Association (ADA), there are several types of diabetes mellitus:

1. **T1DM**, an insulin-dependent or juvenile-onset disorder affecting 3–10% of the overall.

2. **T2DM**, which is non-insulin dependent or adult-onset in 85–90% of cases.

3. **Gestational diabetes mellitus**, which develops in the second or third trimester of pregnancy and causes hyperglycemia that often goes down after delivery.

T1DM is frequently accompanied by changes in lipid metabolism, a boost in oxidative stress brought on by hyperglycemia, instability in endothelial cells, the loss of pancreatic beta cells, and cellular damage [2].

T2DM causes ER stress, apoptosis, glucotoxicity, and lipotoxicity, all of which lead to the gradual loss of beta cells [3]. The primary signs and symptoms include polyuria, polydipsia, polyphagia, and nocturia. The aftereffects include abnormalities of the micro- and macrovascular systems, including retinopathy, nephropathy, and neuropathy. Many studies have shown that insulin resistance (IR) is the main factor contributing to diabetic mellitus (DM) problems [4]. As a result, many pathogenic disorders, however the exact mechanism is yet unknown, use to contribute to insulin resistance [5]. Suppressing intestinal α-glucosidase and preventing pancreatic α-amylase from degrading complex polysaccharides are two effective therapies for type 2 diabetes. In the treatment of diabetic disease, commercial drugs such as acarbose, miglitol, and voglibose are used to block α-glucosidase. Inhibiting α-glucosidase and α-amylase enzymes over an extended period of time can be beneficial in treating type-2 diabetes [6].

2. METHODS OF MUSHROOMS DRAW BACK BLOOD GLUCOSE

Mechanisms of polysaccharides reduce blood glucose

In addition to monosaccharide units, complex carbohydrates also have glycosidic connections that hold them together. Depending on how much monosaccharide they include, they can be either homopolysaccharides or heteropolysaccharides. With either form of polysaccharide, monosaccharides can unite linearly or branch out to create complex structures. Higher basidiomycetous mushrooms were discovered to have a significant amount of beta-D-glucans, a family of physiologically active polysaccharides, in a prior study. Prebiotic bacteria can significantly help with the management and prevention of obesity, cardiovascular disease, diabetes, and cancer. Dietary fibre known as -glucan, which is present in sources including mushrooms, yeast, and cereal grains, is also considerably supported by prebiotic microorganisms [7,8].

Among the fungi that contain β-glucan are the edible mushrooms Lentinusedodes, Agaricusblazei, Schizophyllum commune, Ganodermalucidum, Agaricusbrasiliensis, Pleurotusflorida, and Lentinussquarrosulus [9]. Mushroom -glucans are non-starch polysaccharides with an additional -(1-6) branch point and -(1-3) connections in the glucan main chain. A core made of glucose polymerchains is also present [10].

DIMINISHING THE POTENCY OF GLUCOSE ABSORPTION

Polysaccharides may lessen diabetes, which lowers the efficiency of glucose absorption and postprandial glycemia due to its effect on gastrointestinal viscosity. Polysaccharides and water-soluble dietary fibres make gastrointestinal fluid more viscous, which reduces the amount gastric emptying and postpones food breakdown and glucose absorption. Moreover, there are indications that polysaccharide may have the capacity to bind and adsorb glucose, maintaining a low glucose level in the small intestine [11]. Because the polysaccharides in Agaricus campestris and Coriolus versicolor are hydrosolubilized, they may inhibit the movement of nutrients towards the villi network for effective absorption by the thickened intestinal contents, lowering glycemia. Cordyceps sinensis, Paecilomyces japonica, Armillariella mellea, and Fomesfomentarius may also have this effect [12].

PANCREATIC β-CELL MASS IMMENSELY INCREASES

The secretory pancreas is made up of dormant cells that can grow and replace unhealthy or dead cells, and it has a great deal of capacity to respond to changes in insulin demand [13, 14]. The development of effective nutrient-based diabetes treatments therefore requires study into several mushrooms that promote the renewal of pancreatic beta cells [14]. The increased expression of the chemokine CXCL12 protein, which mediates the recovery of the -cell population by activating the serine/threonine-specific Akt protein kinase prosurvival pathway, is one of the mechanisms linked to the increase in the number of functional insulin-positive -cells that has been observed [15]. In the early phases of diabetes development, when it may be possible to renew and expand the bulk of pre-existing beta cells, this method is critical. Also common in type 2 diabetes are decreased beta-cell mass and increased beta-cell death, which are linked to increased Bax expression and decreased Bcl-2 levels [16].

ACTIVATION OF INSULIN SIGNALING PATHWAYS

During physiological circumstances, insulin produced soon after a meal activates the IRS/phosphoinositide 3-kinase (PI3K)/Akt signalling cascade. The key player in the regulation of glucose metabolism is Akt, which activates phosphofructokinase and inhibits glycogen synthase kinase 3 (GSK-3), enhancing glucose absorption and reducing gluconeogenesis in the liver and muscle [17]. In addition to regulating lipid and glucose metabolism, body lipid deposition, and pancreatic insulin production, the IRS/PI3K/Akt signalling pathway also regulates these processes [18]. These findings demonstrated that PSG-1 therapy regulates GLUT4 translocation via PI3K/Akt signalling pathways, which in turn regulates hepatic glucose absorption in type 2 diabetic rats [19,20]. The aforementioned information indicates that I. obliquus polysaccharides' ability to lower blood sugar levels involved PI3K/Akt phosphorylation activation of insulin signalling and enhanced production of GLUT4 in adipose tissues in diabetic mice to enhance glucose transport. Rats with type 2 diabetes brought on by STZ were given total Pleurotusostreatus polysaccharides for four weeks; this reduced hyperglycemia. Reduced insulin resistance and improved glycogen storage were achieved through GLUT4 translocation in muscle tissue and activation of GSK-3 phosphorylation in the liver [21].

MECHANISM OF TERPENOIDS IN LOWERING BLOOD GLUCOSE

Terpenes are important bioactive byproducts that many higher fungus produce. They are divided as monoterpenes, sesquiterpenes, diterpenes, sesterpenes, triterpenes, tetraterpenes, and politerpenes based on how many isoprene (C5H8) units they contain. Terpenoids, the oxygenation derivatives of these hydrocarbons, are often referred to as terpenes. Diterpenoids, triterpenoids, and sesquiterpenoids are the typical terpene representatives and have unique biological characteristics. Only a small portion of the tri- or sesquiterpenoids, which make up the majority of mushroom metabolites, resemble the terpenoid molecules found in plants. Due to their tendency to cling to cell membranes due to their lipophilic nature, triterpenes may have a limited bioavailability. Triterpenoids have been demonstrated to penetrate cell membranes and traverse the blood-brain barrier despite their small size, building up inside the liver, blood vessels, and other organs [22]. Regular usage of naturally occurring substances rich in triterpenes also increases their absorption into the bloodstream and tissue deposition. The inhibition of enzymes involved in the process of metabolising glucose, such as -glucosidase and aldose reductase, has previously been connected to the anti-diabetic actions of terpenoids. [23].

POTENT INHIBITOR OF α-GLUCOSIDASE

Controlling postprandial hyperglycemia is one of the most crucial and effective diabetes management techniques. Dietary carbohydrates are broken down to create monosaccharides, such as glucose and fructose, which the small intestine can easily absorb and pump into the bloodstream. One of the essential enzymes for digesting carbohydrates, glucosidase, is found in the small intestinal epithelium. It is essential for turning oligo- and disaccharides into glucose. Because it significantly lowers the conversion of polysaccharides into blood glucose, inhibiting α-glucosidase is a useful strategy for managing blood glucose levels in diabetes and an efficient technique to control postprandial blood glucose levels [24]. More than 140 triterpenoids from fungi in the genus Ganoderma have been identified, making them the primary bioactive substances among the many compounds found there. Up to 15 triterpenoids have surprisingly been found in G. lucidum. These naturally occurring compounds and structurally highly oxidised lanostanes make up the isolated triterpenoids [25].

3. CONCLUSION

A variety of edible mushrooms are still untapped for their potential value addition in culinary products. Because they possess a variety of nutritional and sensory properties, these particular mushroom species set themselves apart from species that are frequently consumed. Given the growing consumer demand for diets that are healthier and more sustainable, the use of mushrooms in foods for muscles is likely to continue growing. Mushrooms' anti-diabetic properties are correlated with their polysaccharide (β-D-glucan) and vitamin D content. The link between vitamin D and insulin resistance needs special attention due to its potential consequences. The commercial production of drugs for the treatment of cancer can be sped up by a better knowledge of the molecular principles underlying the activity of mushrooms. Mushrooms are expected to rank among the top nutraceutical foods that can be taken as a daily supplement, given the current state of our understanding of nutrigenomics and molecular nutrition. Basically, we were able to confirm the mushrooms' varied spectrum of several health beneficial activities.

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