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Kanchan Kumari

Department of Agriculture &
Food Processing Guru Nanak
College, Budhlada, Mansa,
Punjab, India

Mushrooms as source of dietary fiber and its medicinal value: A review article

Kanchan Kumari

Abstract

Mushrooms had long been used for medicinal and food purposes since decades. It is now known good health can be maintained by correct diet which controls and modulates many functions of human body, it can reduce the risk of many diseases. Modern pharmacological research confirms large parts of traditional knowledge regarding the medicinal effects of mushrooms due to their antifungal, antibacterial, antioxidant and antiviral properties, besides being used as functional foods. Foods with dietary fiber are in great demand now- a- days due to their various benefits. Mushrooms are valuable resources for food, medicine and nutraceuticals. Edible mushroom has a rich dietary content but composition in edible mushroom varies greatly with its morphological stages including fruit body, mycelium and sclerotium. This paper sums up diverse beneficial health effects of mushrooms to humans, as a dietary fibre, and an important source of medicines.

Keywords: Mushroom, medicinal value, dietary fiber and nutraceuticals

Introduction

Mushrooms are edible fungus that can provide several important nutrients. Mushrooms are the only natural, non-fortified edible source of vitamin D and they contain beneficial minerals like selenium, potassium, iron, copper, and phosphorus. These fungi also supply choline, a nutrient that has been found to help improve sleep, muscle movement, memory, and learning. Internally, choline works to maintain cellular membrane structure, support adequate fat absorption, help transmit nerve impulses, and reduce chronic inflammation.

Table 1: Proximate Composition of mushrooms (n=3)

Raw materials	Moisture (%)	Protein (%)	Fat (%)	Ash (%)	Crude Fibre (%)
Mushrooms	89.33±0.07	2.67 ± 0.12	0.21 ± 0.01	0.53 ± 0.02	5.78±0.04

Mushrooms and Health

A growing number of studies confirm that eating a variety of plant-based foods is linked with reduced risk of lifestyle-related health problems. Like tomatoes, bell peppers, carrots, and other colorful vegetables, mushrooms are rich in antioxidants. Mushrooms are among those plant-based foods that help us avoid obesity, heart disease, and mortality in general.

Cancer

Because mushrooms are rich in selenium, eating them helps boost liver enzyme function. This liver action can help detoxify cancer-causing compounds. Additionally, selenium helps reduce or prevent inflammation and stunt tumor growth rates. The vitamin D content in mushrooms also lends itself to cancer inhibition; vitamin D has been demonstrated to help regulate the cell growth cycle. Folate content helps with DNA synthesis and repair, which aids in preventing cancer cells and DNA mutations from forming in the first place.

Heart Health

Cardiovascular health gets a boost from the potassium, vitamin C and fiber present in mushrooms. Along with sodium, potassium helps to regulate blood pressure. Because mushrooms are high in potassium and low in sodium, eating mushrooms can help decrease the risk of high blood pressure and cardiovascular disease.

Diabetes

The high fiber content in mushrooms about 3 grams in one cup can help people with type 1 diabetes lower their blood sugar levels. Type 2 diabetics can see improved blood glucose, lipids, and insulin levels. Diabetes is not a prerequisite to load up on fiber, however.

Corresponding Author:**Kanchan Kumari**

Department of Agriculture &
Food Processing Guru Nanak
College, Budhlada, Mansa,
Punjab, India

Current dietary guidelines recommend a daily intake of 25 grams of fiber for women and 38 grams for men.

Satiety and Weight Loss

The two kinds of dietary fiber in mushrooms are beta-glucans and chitin. They both increase satiety and reduce hunger pangs.

Immune Respons

The selenium content in mushrooms also helps boost your immune system's response because it stimulates t-cell production. Mushrooms' beta-glucans fibers also stimulate the immune system, helping in fight cancer cells and prevent tumors from developing.

Definition of dietary fiber

The definition of dietary fiber proposed by Institute of Medicines is that dietary fiber consists of non digestible carbohydrates that have beneficial physiologic effects in humans. Total fiber is the sum of dietary fiber and functional fiber^[1].

Traditionally, dietary fiber was defined as the portions of plant foods that were resistant to digestion by human digestive enzyme; this included polysaccharides and lignin. More recently, the definition has been expanded to include oligosaccharides, such as inulin, and resistant starches^[2].

The definition of dietary fiber (DF) proposed by American Association of Cereal Chemists (AACC) defines Dietary Fiber is the edible part of plants or analogous carbohydrates that are resistant to digestion and absorption in the human small intestine having beneficial physiological effects such as laxation, blood glucose attenuation^[3].

More specifically, dietary fiber means carbohydrate polymers with ten or more monomeric units, which are not hydrolyzed by the endogenous enzymes in humans^[4]. These non-digestible carbohydrate (NDC) polymers should occur naturally in the food as consumed and have been obtained from food raw material by physical, enzymatic or chemical means and which have been shown to have a physiological effect of benefit to health as demonstrated by generally accepted scientific evidence to competent authorities^[4].

Types of fibers

Dietary fiber is frequently classified as soluble or insoluble. Soluble fibers dissolve in water and consist of pectins, gums and some hemicelluloses. Soluble fiber has been shown to be effective in reducing the risk of cardiovascular disease and diabetes by reducing total blood cholesterol and regulating blood sugar levels. Soluble fiber is found in foods like oat bran and barley bran. Fiber from over-the counter laxatives usually contain soluble fiber also in the form of psyllium.

Insoluble fibers do not dissolve in water and consist of cellulose, lignin and some hemicelluloses. Insoluble fiber has been shown to be effective in reducing the risk of colon cancer and treating constipation. Whole grains are good sources of insoluble fiber^[5].

Insoluble fiber, is found in foods like wheat bran, whole grains, and all fruits and vegetables. It is often referred to as roughage or bulk because it keeps the digestive system functioning normally. Insoluble fiber helps with constipation, hemorrhoids, and other digestive problems. Most fiber containing foods include approximately one-third soluble and two-third insoluble fiber^[6].

Sources of dietary fiber

Pears: Martin-Cabrejas *et al.*^[7] evaluated dietary fiber products prepared from pomaces. Pear pomace contained 43.9% total dietary fiber (DMB) Soluble dietary fiber in pomace was primarily high methoxyl pectin^[7].

Oranges: Ting & Rouseff^[8] analyzed the alcohol-insoluble solids from peel and pulp remaining after production of juice from two varieties of oranges and one variety of grapefruit.

Mango: Processing mangos yields 35–60% by-products which are a potential source of dietary fiber^[9].

Olives: Valiente *et al.*^[10] studied the composition and enzymatic modification of the fiber fraction of olive cake, a by-product of olive processing. Total dietary fiber content was reported to be 800 g/kg dry matter with the majority being insoluble.

Carrots: The effect of blanching on characteristics of carrot pulp remaining after juice extraction was investigated by Bao & Chang^[11]. The blanched pulp contained 37–48% total dietary fiber, 4–5% protein, 8–9% reducing sugars and 5–6% minerals. Larrauri *et al.*^[12] compared a fiber product prepared from pineapple shells to commercial fibers made from apple and citrus fruits. Pineapple shell fiber contained 70.6% total dietary fiber, the majority of which was insoluble. Xylose and glucose were the major neutral sugars detected in the fiber product. Antioxidant activity of the pineapple fiber, which was potentially due to the presence of the polyphenol myricetin, was much higher than that detected in apple and citrus fibers. The pineapple fiber was also reported to have neutral color and flavor properties which could improve the acceptability of the product as a dietary fiber supplement^[12].

Mushrooms as source of Dietary Fiber

One type of fiber found in mushrooms is called beta-glucan and is similar to the main fiber in oat products. Beta-glucan is beneficial for blood sugar and blood cholesterol management. While mushrooms may not be the best dietary source of fiber, they do provide additional nutrients such as the B vitamins pantothenic acid, riboflavin and niacin, and the minerals selenium, copper and potassium. Compared to other conventional sources of dietary fiber, such as cereals, fruits, legumes and vegetables, mushrooms or fungi are underutilized^[13, 14].

Edible mushrooms are a rich source of dietary fiber that have various beneficial health effects to humans. Plant cell walls are major sources of dietary fiber, mushroom cell walls can also be considered as dietary fiber. Mushroom cell walls contain a mixture of fibrillar and matrix components which include chitin (a straight-chain (1→4)- β -linked polymer of *N*-acetyl-glucosamine) and the polysaccharides such as (1→3)- β -*D*-glucans and mannans, respectively^[15]. From nutritional value point of view, mushrooms are ranked after meat and before vegetable; The results of experiments indicates that button mushroom contains 91.5% moisture, 3.7% protein, 4.2% carbohydrate, 0.3% fat and 1.25% ash^[16]. The protein of mushroom is in the range of 24 to 44% on dry bases that contains 9 essential amino acids^[17]. The amount of fat and calorie in button mushroom is low and it can be considered as a good source of vitamins and materials especially iron, zinc, selenium, potassium, and phosphorous^[18, 19]. In addition to high nutritional value, button mushrooms' medicinal properties are proved. It is suggested that the reason for these

properties might be related to the dietary fiber compounds especially chitin and beta glucan which can be found in button mushroom [20]. Mushroom also has anti oxidant properties because of phenolic compounds which will reduce the risks related to free radicals [21].

Health benefits of mushroom DF

Mushroom sclerotium has medicinal effects because of high level of β -glucans (>80% DM) that are beneficial to humans [22]. Various researchers concluded that β -glucans can enhance human's immunity by triggering strong immunomodulatory mediated by cytokine production and signaling cascade as well as direct inhibition of cancer cells. [23-26]. High levels of dietary fiber intake lowers the rate of coronary heart disease, stroke, and peripheral vascular disease. Jensen *et al.* [2004] [27] reported that an increased daily consumption of bran significantly decreased the risk of coronary heart disease in healthy adult men. Higher levels of fiber consumption lower the risk of hypertension, diabetes, obesity, and dyslipidemia in human beings. [Lairon *et al.* 2005] [28]. Theuwissen and Mensink [2008] [29] found that, many well-controlled intervention studies have shown that four major water-soluble fiber types β -glucan, psyllium, pectin and guar gum effectively lower serum LDL cholesterol concentrations, without affecting HDL cholesterol or triacylglycerol concentrations. Consumption of dietary fiber decreases energy absorption by diluting energy content of meal and maintains other important nutrients [Lattimer and Haub 2010] [30].

Therefore, DF research has drawn much concern recently, particularly in the growing nutraceutical industry [31, 32]. Different source of dietary fiber has different structures, chemical composition, and physico-chemical properties and this would exhibit different nutritional, technological and physiological benefits [33, 34].

Gbolagade *et al.* (2006) [35] studied the mushrooms which were growing in the wild were nutritious and important for medicinal purposes. Mushrooms had been considered as rich food because they contain protein, sugars, glycogen, lipids, vitamins, amino acids and crude fibres. They also contain important mineral nutrients, which were required for normal functioning of the body. Infact, Bano suggested that food value of mushrooms lies between meat and vegetables.

Barros *et al.* (2007) [36] concluded, the chemical composition and energy values of the Portuguese wild edible mushrooms and indicated that they provide key nutrients such as protein, unsaturated fatty acids, and carbohydrates. Being a good source of protein and carbohydrate, they fell between most legumes and meat, and proved to be excellent foods that could be used in low caloric diets for their low contents of fat and energy.

Barros *et al.* (2008) [37] analyzed mushrooms containing very useful nutraceuticals such as UFA, phenolics, tocopherols, ascorbic acid, and carotenoids which could be extracted for the purpose of being used as functional ingredients namely against microbial infections. Public health authorities consider prevention and treatment with nutraceuticals a powerful instrument in maintaining and promoting health, longevity and life quality. The beneficial effects of nutraceuticals will undoubtedly have an impact on nutritional therapy; they also represent a growing segment of today's food industry. Besides, these mushrooms might be used directly in diet and promote health, taking advantage of the additive and synergistic effects of all the bioactive compounds present.

Abah *et al.* (2010) [38] analysed the phenolics composition of *A. bisporus* methanolic extracts by High Performance Liquid Chromatography (HPLC) and found to contain rutin, gallic acid, caffeic acid and catechin which contributed to the antimicrobial and antioxidant activity. Total phenol (280-480mg/l) and ascorbic acid (2.0 \pm 1.0mg/g) contents also contributed to its antioxidant activity. *A. bisporus* was a natural source of antioxidant and antimicrobial agent against the tested organisms and had a potential as anticancer agent.

Adedayo *et al.* (2010) [39] concluded that the inclusion of edible mushrooms into the diet had a hypocholesterolemic effect, perhaps due to dietary fibres such as beta-glucans which may increase intestinal motility, reducing bile and cholesterol absorption. The low pH (6.1 - 7.2) and low titratable acid in the samples further suggests why they might be edible; they were neither acidic nor basic so they were not likely to contain toxins which could be harmful to man or animal.

Mushrooms have been found effective against cancer, cholesterol reduction, stress, insomnia, asthma, allergies and diabetes (Bahl, 1983) [40]. Due to high amount of proteins, they can be used to bridge the protein malnutrition gap.

Conclusion

We may conclude about the diverse benefits of mushrooms towards humans by the words of the father of medicine that is, Hippocrates "Let food be your medicine and medicine be your food". This saying aptly suits mushrooms, as they have tremendous medicinal food, drug and mineral values, hence they are valuable asset for the welfare of humans.

A high level of fiber intake has health-protective effects and disease-reversal benefits. Persons who consume generous amounts of dietary fiber, compared to those who have minimal fiber intake, are at lower risk for developing; Cardiovascular health disease, hypertension, diabetes, obesity, and certain gastrointestinal diseases. Increasing the intake of high fiber foods or fiber supplements improves serum lipoprotein values, lowers blood pressure, improves blood glucose control for diabetic individuals, aids weight loss, and improves regularity.

In general, edible mushrooms are underutilized to be a source of dietary fiber at present. This would greatly facilitate the application of mushroom DF as functional food ingredient or product that can provide various health benefits to humans in the future. In today's urban life, due to less mobility and increased diseases, the consumption of these kinds of products as a rich source of fiber which might have direct effect on people's health is suggested.

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