



NUTRITIONAL VALUE OF MUSHROOM

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ABSTRACT

Mushrooms used for food purposes from a long times but now a day it was recognized as correct dietary food for maintain our health and preventing a number of diseases. Mushroom contain a number of medicinal properties like antibiotic, antifungal, antibacterial and antioxidant properties so, now a day it can also be used as functional food . This paper represents diverse nutraceutical properties of mushroom for human beings.

KEYWORDS: *Mushrooms, nutraceutical, health, properties.*



INTRODUCTION

Mushroom is a fruiting body of higher fungi. It grow on lingo-cellulosic agro waste .Only fruiting bodies of the mushroom can be seen where as the rest of the mushroom remains underground as mycelium. Mushroom are more palatable rich in protein, mineral, vitamins, fiber and constitute a balance human diet. These have been rightly recommended by Food and Agriculture Organization (FAO) as food contributing to protein nutrition in developing countries depending largely on cereals. The protein contents of mushrooms about twice as high as that in most vegetables. The digestibility of mushroom protein ranges between 71-90 percent. Mushroom not only constitutes a valuable source of nutritive food for man but also contains a number of medicinal properties. They are ideally suited for diabetic and other diseased persons. These have also been reported to posse's antiviral and anticancer properties. Mushroom has been found effective in cholesterol reduction, stress, asthma, allergies (Bhal 1983). Mushroom as functional foods are used as nutrient supplements to enhance immunity. Due to low starch content and low cholesterol they are suited for diabetic and heart patients. One third of iron in the mushroom is in available form. Their polysaccharide content is used as anti-cancerous drugs. Even they have been used to combat HIV effectively (Nanba, 1993; King, 1993). Thus keeping in view the tremendous applications of mushroom, the present study reviews the different aspects of mushroom towards human health benefits such as food, medicine, minerals, drugs etc. 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.

Mushrooms as a source of food

From a long times fruit body of mushroom have been used as a source of food (Mattila et al., 2001)due to their chemical composition which is attractive from the nutritional point of view.

Mushroom were consumed mainly for their palatability and unique flavors (Rai; 1994, 1997). Now a day the use of mushroom as a food is totally different from traditional because a lot of research has been done on the chemical composition of mushroom which revealed that mushroom can be used as a diet to combat diseases. History regarding the use of mushroom in different countries has been reviewed by a number of workers (Buller, 1915; Rolfe and Rolfe 1925, Singer, 1961; Atkinson, 1961; Bano and Rajarathanum 1982; Honghton, 1995). Rolfe and Rolfe (1925) mentioned that the mushroom like *Agaricus campestris*, *Morchella esculenta*, *Helvella crispa*, *Hydnum coralloides*, *Hypoxylon vernicosum* and *Polyporus mylittae* were used much earlier in India. Lintzel (1941) recommended that 100 to 200 gm of mushroom (dry weight basis) is required to maintain an optimal nutritional balance in a man weighing 70 kg. Bano et al. (1963) determine the nutritive value of *Plurotus flabellatus* as 0.974% ash, 1.084% crude fibre, 0.105% fat, 90.95% moisture, 0.14% non protein nitrogen and 2.75% protein. Bano (1976) suggested that food value of mushroom lies between meat and vegetable. Crisan and Sands (1978) observed that mushroom in general contain 90% water and 10% dry matter. Orgundana and fagade (1981) indicated that an average mushroom is about 16.5% dry matter, out of which 7.4% is crude fibre, 14.6% is a crude protein and 4.48% is fat and oil. Gruen and wong (1982) indicated that edible mushroom were highly nutritional as compared to meat, egg and milk food sources. Of, several thousand mushroom sp. Known worldwide only around 2000 are considered edible, of which about 20 cultivated commercially with only 4 to 5 under industrial production (Chang, 1990). There is also a significant difference in the nutrient content of different fruiting body part of mushroom (Latifah et al. 1996; Zakia et al. 1993).

Protein:

Protein is one of the important content of fruiting body of mushroom (Alector 1995, Alofe et al. 1995; Fasidi and kadiri 1990; Chang and Buswell 1996). The digestibility of mushroom protein to be as high as 72-83%. The protein contents of mushroom depends upon the substrate on which it grow, size of fruiting body, duration of harvesting and sp. of mushrooms (Bano and Rajarathanum 1982). The protein content of mushroom also vary from flush to flush Crisan and Sand 1978. Haddad and Hayes (1978) indicated that protein in *A.bisporus* mycelium ranged from 32 to 42% on the dry weight basis. Samajpati 1978 found 30.16, 28.16, 34.7 and 29.16% protein in dried mycelium of *A. campestris*, *A.arvensis*, *M.esculenta* and *Morchella deliciosa* respectively. Purkaystha and Chandra (1976) found 14-27% crude protein on dry weight basis in *A.bisporus*, *lentinus subnudus*, *calocybe indica* and *Volvariella volvacea*. On dry matter basis the protein content of mushroom varies between 19/100 and 39/100 gm (Weaver et al. 1977); Breene, 1990. In term of the amount of crude protein mushroom rank below animal meats but well above most other food including milk (Chang, 1980) On dry weight basis mushroom normally contain 19-35% proteins as compared to 7.3% in rice, 12.7% in wheat, 38.1% in soyabean and 9.4 in corn (Crisan and Sand 1978; Li and Chang, 1982; Bano and Rajarathnam 1988. Verma et al. 1987 reported that mushroom are very useful for vegetarian because they contain some essential amino acid which are found in animal proteins. Rai and Saxena 1989a observe the decreasing in the protein content of mushroom on storage. The protein conversion efficiency of edible mushroom per unit of land and per unit time is for more superior as compared to animal source of protein (Bano and Rajarathnam 1988). Mushroom in general have higher protein content than most other vegetable (Bano and Rajarathanm 1988) and most of the wild plants (Kallman, 1991). Sharma et al. (1988) reported 14.71 to 17.37% and 15.20% to 18.87% protein in the fruiting bodies of *Lactarius delicious* and *Lactarius sanguifus* respectively. Mushroom contain all the essential amino acid require by adult (Hayes and Haddad 1976) Gupta and singh (1991) reported 41.4% essential amino acid in *Podaxis pistrillans*. Friedman (1996) reported that the total nitrogen content of dry mushroom is contributed by protein amino acid revealed that crude protein is 79% compared with 100% for an ideal protein.

Carbohydrates:

The carbohydrate content of mushrooms represents the bulk of fruiting bodies accounting for 50 to 65% on dry weight basis. Free sugars amounts to about 11%. Florezak et al. (2004) reported that *Coprinus atramentarius* (Bull.: Fr.) Fr. contain 24% of carbohydrate on dry weight basis. The mannitol, also called as mushroom sugar constitutes about 80% of the total free sugars, hence it is dominant (Tseng and Mau, 1999; Wannet et al., 2000). Mc-Connell and Esselen (1947) reported that a fresh mushroom contains 0.9% mannitol, 0.28% reducing sugar, 0.59% glycogen and 0.91% hemicellulose. Carbohydrates of *Agaricus bisporus* were reported by Crisan and Sands (1978). Raffinose, sucrose, glucose, fructose and xylose are dominant in it. (Singh and Singh, 2002). Water soluble polysaccharides of mushrooms are antitumor (Yoshioka et. al., 1975).

Fat:

In mushrooms, the fat content is very low as compared to carbohydrates and proteins. The fats present in mushroom fruiting bodies are dominated by unsaturated fatty acids. Singer (1961) determined the fat content of some mushrooms as 2.04% in *Suillus granulatus*, 3.66% in *Suillus luteus* and 2.32% in *A. campestris*. Hugaes (1962) observed that mushrooms are rich in linolenic acid which is an essential fatty acid. Total fat content in *A. bisporus* was reported to be 1.66 to 2.2/100 g on dry weight basis (Maggioni et al., 1968). Ogundana and Fagade (1981) indicated that mushrooms have 4.481% fats on dry weight basis. Kanwar et al. (1990) has reported a fat content of 11.52% in the *Amanita ceasarea* fruiting bodies on dry weight basis. In 100 g fresh matter of *A. bisporus* (Lange) Sing and *Pleurotus ostreatus* (Jacq: Fr.) Kumm, the content of fatty compounds were found to be 0.3 and 0.4 g respectively (Manzi et al., 2001), but on dry weight basis, it is 2 and 1.8 g respectively (Shah et al., 1997). Aletor (1995), Manzi et al. (2001), Sanme et al. (2003) and Manzi et al. (2004) worked on the fibre content of different mushrooms. Mushrooms are considered good source of fats and minerals (Jiskani, 2001). Yilmaz et al. (2006) and Pedneault et al. (2006) reported that fat fraction in mushrooms is mainly composed of unsaturated fatty acids.

Vitamins

Mushrooms are one of the best sources of vitamins especially Vitamin B (Breene, 1990; Mattila et al., 1994; Zrodowski, 1995; Chang and Buswell, 1996; Mattila et al., 2000). Vitamin content of edible mushrooms has been reported by Esselen and Fellers (1946), Block et al. (1953) and Litchfield (1964). Manning (1985) gave a comprehensive data of vitamin content of mushrooms and some vegetables. According to Mattila et al. (1994), wild mushrooms contain much higher amounts of vitamin D2 than dark cultivated *A. bisporus*. Mushrooms also contain vitamin C in small amounts (Sapers et al., 1999; Mattila et al., 2001) Mushroom are poor in vitamins A, D, and E (Anderson and Fellers, 1942).

Mineral constituents

The fruiting bodies of mushrooms are characterized by a high level of well assimilated mineral elements. Major mineral constituents in mushrooms are K, P, Na, Ca, Mg and elements like Cu, Zn, Fe, Mo, Cd form minor constituents (Bano and Rajarathanum, 1982; Bano et al., 1981; Chang, 1982). K, P, Na and Mg constitute about 56 to 70% of the total ash content of the mushrooms (Li and Chang, 1982) while potassium alone forms 45% of the total ash. Abou-Heilah et al. (1987) found that content of potassium and sodium in *A. bisporous* was 300 and 28.2 ppm respectively. *A. bisporus* ash analysis showed high amount of K, P, Cu and Fe (Anderson and Fellers, 1942). Kaul (1978) reported that *M. esculenta* contains Ca (0.5776 mg), P (3.313 mg), Fe (1.213 mg) and K (3.831 mg). Varo et al. (1980) reported that *A. bisporus* contains Ca (0.04 g), Mg (0.16), P (0.75 g), Fe (7.8 g), Cu (9.4 mg), Mn (0.833 mg) and Zn (8.6 mg) per kilogram fresh weight. Mushrooms have been found to accumulate heavy metals like cadmium, lead, arsenic, copper, nickel, silver, chromium and mercury (Schmitt and Sticher, 1991; Mejstrick and Lepsova, 1993; Wondratschek and Roder, 1993; Kalac and Svoboda, 2000; Svoboda et al., 2001; Issiloglu et al., 2001; Malinowska, 2004). The mineral proportions vary according to the species, age and the diameter of the fruiting body. It also depends upon the type of the substratum

(Demirbas, 2001). The mineral content of wild edible mushrooms has been found higher than cultivated ones (Aletor, 1995; Mattilla et al., 2001; Rudawska and Leski, 2005).

Medicinal importance

Medical mycology is as old as traditional uses of mushrooms. They have been used in medicine since the Neolithic and Paleolithic eras (Samorini, 2001). First century Greek physician Dioscorides, included the lurch polypore, (*Fomitopsis officinalis* (Villars: Fr.) Bond and Singer, *Polyporaceae*; syn. *Laricifomes officinalis* (Villars: Fr.) in his *De Materia medica* known then as *Agaricum* and latter as the Quinine conk. It was used for the treatment of "consumption", a disease now known as tuberculosis. Although mushrooms as medicine have been used in China since 100 A.D. (Gunde, 1999), but it was only in 1960 that scientists investigated the basic active principles of mushrooms which are health promoting. Mushrooms have been used in health care for treating simple and age old common diseases like skin diseases to present day complex and pandemic disease like AIDS. They are reputed to possess anti-allergic, anticholesterol, anti-tumor and anti-cancer properties (Jiskani, 2001). Aqueous extracts from *Pleurotus sajor caju* proves good in renal failure (Tam et al., 1986). The first successful research discovered the antitumor effects of the hot water extracts from several mushrooms (Ikekawa et al., 1969). The main components proved to be polysaccharides especially β -D- glucans. Chihara et al. (1969) isolated from the shiitake fruiting bodies, an antitumor polysaccharide, which was named *lentinan*. Bahl (1983) reported that mushrooms cure epilepsy, wounds, skin diseases, heart ailments, rheumatoid arthritis, cholera besides intermittent fevers, diaphoretic, diarrhea, dysentery, cold, anesthesia, liver disease, gall bladder diseases and used as vermicides. Most of the mushroom drugs are now available in tablet form in China (Yang et al., 1993). In underdeveloped countries where protein malnutrition has taken epidemic proportions, Food and Agricultural Organization (F. A. O.) has recommended mushroom foods to solve the problem of malnutrition (Sohi, 1988). Mannentake (*Ganoderma lucidum*) are known to lower blood pressure and serum cholesterol concentration of hypertensive rats (Kabir et al., 1988). *Lentinus tigrinus* and *G. lucidum* are proved anticholesterolmic (Ren et al., 1989). *Lentinus edodus* has been used to enhance vigour, sexuality, energy and as an anti aging agent (Gareth, 1990). Lentinan sulphate obtained from *Lentinus* species inhibits HIV (Gareth, 1990). Jong et al. (1991) reported that mushrooms cause regression of the disease state. Mushroom medicines are without side effects (Sagakami et al., 1991). Puffballs have been used in urinary infections (Buswell and Chang, 1993). Maitake extract has been shown to kill HIV and enhance the activity of T-helper cells (Nanba, 1993; King, 1993). *Ganoderma* nutraceuticals have exhibited promising antiviral effects like, anti-hepatitis B (Kino et al., 1989), anti-HIV (Kim et al., 1993; Liu and Chang, 1995). Dreyfuss and Chapela (1994) reported hundreds of secondary metabolites of fungal origin possessing biological activity. Mushrooms act as biological response modifiers by promoting the positive factors and eliminating the negative factors from the human body and thus regarded as the fourth principal form of the conventional cancer treatment (Yang et al., 1993). *G. lucidum* (Fr.) Karst is believed to act as an anti-inflammatory agent (Stavinoha et al., 1991); acts as antidiabetic (Teow, 1997). It is also used by Indian tribals for treating joint pain (Harsh et al., 1993). Hobbs (1995) reported various medicinal uses of mushrooms like reishi, cordyceps, enoki, maitake, lion's mane and splitgill for cancer treatment; shiitake, blazei, reishi, enoki, cordyceps, maitake, mesima and oyster were found effective against cholesterol reduction. Reishi, cordyceps, shiitake and maitake is used for reducing stress. Lion's mane has been used for memory improvement; reishi for inducing sleep, cordyceps for physical endurance and sexual performance, reishi, cordyceps, chaga and lion's mane for asthma and allergy treatment. Shiitake, cordyceps, chaga and turkey tail as liver protectants; reishi, maitake, turkey tail and shitake for treating diabetes. It is also believed to be a good health elevator (Mizuno, 1996). *Auricularia* species were used since times for treating hemorrhoids and various stomach ailments (Chang and Buswell, 1996). *Pleurotus tuber-regium* mushroom have been used for curing headache, high blood pressure, smallpox, asthma, colds and stomach ailments (Oso, 1997; Fasidi and Olorumaiye, 1994). It has been reported that *P. ostreatus* lowers the serum cholesterol concentration in Wani et al. 2601 rats (Bobek et al., 1996). PSK, an anticancer drug from the mushroom, *Coriolus versicolor* accounted for 25.5% of the

country's total sales in Japan in 1987 as anticancer drug (Chang and Buswell, 1996). Puffballs (*Clavatia*, *Lycoperdon*) have been used for healing wounds (Delena, 1999). Pharmaceutical substances with potent and unique health enhancing properties have been isolated from mushrooms (Wasser and Weis, 1999). Fresh mushrooms are known to contain both soluble and insoluble fibres; the soluble fibre is mainly beta-glucans polysaccharides and chitosans which are components of the cell walls (Sadler, 2003). Soluble fibre present in mushrooms prevents and manages cardiovascular diseases (Chandalia et al., 2000). Wasser (2005) reported that mushroom health supplements are marketed in the form of powders, capsules or tablets made of dried fruiting bodies, extracts of mycelium with substrate, biomass or extract from liquid fermentation. *P. sajor-caju* has been found to be inductive for growth of probiotic bacteria (Oyetayo et al., 2005). *Cordyceps sinensis* also treated as half caterpillar and half mushroom has been known and used for many centuries in traditional Chinese medicine. *Cordyceps* has been used to induce restful sleep, acts as anticancer, antiaging, and antiasthama agents besides proved effective for memory improvement and as sexual rejuvenator (Sharma, 2008).

Antioxidant activity

Antioxidants are chemical compounds that protect cells from the damage caused by unstable molecules known as free radicals. Free radicals are powerful oxidants and those chemical entities that contain unpaired electrons. They are capable of randomly damaging all components of the body, viz. lipids, proteins, DNA, sugars and are involved in mutations and cancers (Przybytniak et al., 1999). The nascent oxygen is trapped by enzymes like superoxide dismutase, catalase and glutathione peroxidase. Over production of free radicals creates oxidative stress. The antioxidants are an important defense of the body against free radicals and mushrooms which are rich sources of these antioxidants (Mau et al., 2004; Puttaraju et al., 2006; Ferreira et al., 2007; Oyetayo et al., 2007). Waxy cap mushroom extracts (*Hygrocybe coccinea*) are inhibitory to sarcoma (Ohtsuka et al., 1997). Immunoceticals isolated from more than 30 mushroom species have shown anticancer action in animals (Wasser and Weis, 1999). Schizophyllan from *Schizophyllum commune* is effective against head and neck cancer (Kimura et al. 1994; Borchers et al., 1999). Antioxidant property of \ compounds is correlated with their phenolic compounds (Velioglu et al., 1998). Kim and kim (1999) reported that mushroom extracts possess DNA protecting properties. *G. lucidum* extracts can trap number of free radicals 2602 J. Med. Plant. Res. (Jones and Janardhanan, 2000). Mau et al. (2001) found antioxidant properties of several ear mushrooms. Many species of mushrooms have been found to be highly potent immune enhancers, potentiating animal and human immunity against cancer (Wasser and Weis, 1999; Borchers et al., 1999; Kidd, 2000; Feng et al., 2001). Tyrosinase from *A. bisporus* is antioxidant (Shi et al., 2002). Lakshmi et al. (2005) determined antioxidant activity of *P. sajor-caju*. Russell and Paterson (2006) observed that triterpenoides are the main chemical compounds in *G. lucidum*. Camptothecin is responsible for antioxidant properties in *G. lucidum* (Zhou et al., 2007).

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