Review Article

Bioactive Chattels and Health Benefit Applications of *Trametes versicolor*

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ABSTRACT

Mushrooms have as of now become an outstanding subject because of their diverse remedial properties. Of these, *Trametes* species have been exploited for epochs in traditional and conventional medication for the treatment of different kinds of ailments and sicknesses. Medicinal properties of *Trametes versicolor* are accentuated in several studies and are surveyed here as review article. The point of features of this review article is to sum up the accessible data on *Trametes versicolor*, including its bioactive components and their properties with different applications in medical advantages and current flow status of scientific exploration.

Key words: Bioactive chemicals, Health, *Trametes versicolor*, Mushroom.

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INTRODUCTION

Trametes versicolor, a fungus commonly referred to as Turkey tail (earlier named and referred as the Many-Zoned Polypore). It can be tracked throughout the year; however it is generally found during the cold weather months where deciduous trees are found. *T. versicolor* acts as fungal parasite and develops essentially on dead hard wooden materials, and also on remnants and standing dead wood just as fallen branches. As mentioned by the compendium of Chinese *Materia Medica*, composed during the Ming Dynasty, in excess of 120 species of *T. versicolor* have been recorded and in traditional Chinese therapeutic practice. This mushroom is viewed as helpful for eliminating poisons, fortifying, energy expanding, improvement of liver and spleen capacity, and upgrading of the insusceptible reaction, particularly when it is dried, ground, and mixed into tea.[1–3] These properties were considered very useful in conventional medicine for chronic use of *Trametes* spp. Preparations.[2]

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In regular medication *Trametes* spp. is utilized essentially for the therapy of different sorts of diseases, yet in addition for persistent hepatitis, rheumatoid joint pain, and contaminations of the respiratory, urinary, and stomach related aches and ailments, which was affirmed by various studies.[2–4] Moreover, resilient antiviral properties of some polysaccharopeptides extracted from *T. versicolor*. Consistent antioxidant activity of extracts of fruiting bodies of *Trametes* spp. has been reported.[5] *Trametes versicolor* has pulled in market consideration and interests as it has potential source of bioactive constituents ready to play out several functions in life forms with benefits for consumer's health.

Bioactive Properties of *Trametes versicolor*

Recently *Trametes versicolor* has enhanced interest among researchers owing to its bioactive properties. Polysaccharopeptide (PSP) and polysaccharopeptide Krestin (PSK) are found to be helpful adjuncts to the treatment of various diseases;[1] *T. versicolor* polysaccharides have likewise shown prebiotic action, invigorating the development of probiotic microscopic organisms. The biomass of *T. versicolor* is more impervious to proteolytic debasement and contains β-glucans as well as different constituents with enormous clinical interest. *T. versicolor* biomass contains an assortment of pertinent enzymes with various exercises, for example, superoxide dismutase,

peroxidase, glucoamylase, protease and laccase.[6] Both PSP and PSK includes β-glucans and D-glucose polymers with β-1,3 and α-1,4 glycosidic linkages, yet some of them can likewise contain other constituents viz. arabinose, fructose, galactose, glucuronic acids, mannose and xylose.[6,7] These bioactive properties are included in Table 1.

PSP and PSK extricated from *T. versicolor* commonly contain 34-35% solvent starches as carbohydrates, 28-35% protein, approximately 7% dampness or humidity, 6-7% ash and rest of free sugars with amino acids.[3,7] Among the 18 kinds of amino acids present, 70% comprise of neutral and acidic amino acids, for example aspartic acid, glutamic acid, alanine, glycine, leucine, serine, threonine and valine.[8] Beneficial health properties detailed throughout the years by Chinese and Japanese analysts have pulled in the consideration of scientific researchers across the world. In this way, numerous clinical studies have been done in recent years with intend to survey and distinguish the primary bioactive properties of polysaccharides extracted from *T. versicolor*.

Health Benefit Properties of *Trametes versicolor*

Many research and reports has been done about the advantages of *Trametes versicolor*. There are a large

Table 1: Bioactive properties and their medicinal benefits.

Bioactive properties	Bioactive compounds	Findings of the study	Reference
Antitumour activity	Polysaccharopeptide (PSP)	IL-2 and PSP can slow progression of H238 tumours. Mechanism of action is related to cytotoxic effects and immunomodulatory properties. PSP expands quantity of monocytes (CD_{14}+/CD_{16}-) which contrasted with controls without PHA. Monocytes were affirmed to utilize antibody response of CD_{14} and MHCII. Staining of cancerous cells with immunoglobulin against the endothelial cell marker (viz. Factor VIII) exhibits positive connection in both vascular thickness and tissue weights. Flow cytometry of cell cycle and programed cell death of Molt 4 cells demonstrates anticancer component of PSP to initiate cell rupture and apoptosis.	[8-11]
	Coriolus versicolor extract (CVE)	*C. versicolor* separated at 50 to 800 Ag/mL portion conditionally smothered the multiplication of NB-4 and HL-60 cells above 90 % (p< 0.01). Extracts of *C. versicolor* treatments resulted immunomodulatory effects by increase in IL-2, IL-6, IL-12 interleukins, TNF-α and IFN-γ production from spleen and lymphocytes of *C. versicolor* treated mice.	[4,12]
	Coriolus versicolor methanol extract	The results demonstrate that *C. versicolor* methanol extract exerts pronounced anti-melanoma activity.	[13]
Prebiotic activity	Polysaccharopeptide (PSP)	*Trametes versicolor* contains putative prebiotic agents that alter human gut microbiota and pH; PSP behaves as prebiotic to modulate and stimulates microbiome.	[14,15]
Antioxidant activity	Polysaccharopeptide Krestin	PSK improved glutathione peroxidase activity through transcriptional induction of mRNA expression.	[16]
	Polysaccharide extracts	Polysaccharide from *T. versicolor, G. applanatum*, *G. lucidum* and *L. edodes* has antioxidant properties.	
Antiviral activity	Polysaccharopeptide (PSP)	PSP proves inhibition of the interface between HIV-l gp120 and immobilized CD_4 receptor.	[2]
Antidiabetic activity	Intra-cellular polysaccharides	Inhibition in α-glucosidase activities were identified with the formation of α-(1,4) glycosidic linkages and the complete level of D-glucose and D-galactose to construct polysaccharides in addition to triterpenoids.	[6,7]
	Polysaccharopeptide (PSP)	PSP can solely retard tol-butamide 4-hydroxylation of pooled human liver microsomes and CYP2C9 *in vitro*.	
Immuno-regulatory effects	*Coriolus versicolor* polysaccharide	CVP can bind to induce B cell activation with membrane Ig and TLR-4 as possible immune receptor. CVP also induce mouse B cells via MAPK & NF-B.	[4,17]
Memory improvement	*Coriolus versicolor* polysaccharide (CVP)	The regulation of GFAP demonstrated reduced inflammation in treated AD mice brain. Expression of superoxide dismutase and catalase levels increased in the brains indicates that oxidation levels were reduced.	[7]
Modulation inAlzheimer diseases	Lipoxin A4 expressed by *Coriolus versicolor*	Initiation of LXA4 signalling and inflection of stress-responsive gene proteins have therapeutic target to AD-related inflammation and neurodegenerative damage	[18]

number of reports of conventional use, just as current scientific investigations contain reports to cure cancer, and boosting immunity. Presently the possible health benefit applications of *T. versicolor* have been acquiring acknowledgment among patients around the world. Aqueous extracts of *T. versicolor* have a wide range of biological activities including modulatory and stimulatory influence, on inhibition of cancer cell growth as well as on different immune cells, has recently been demonstrated. Numerous reports have exhibited that PSK and PSP initiate cellular and humoral immunity of the host. Notwithstanding, *T. versicolor* appears to trigger enzymatic frameworks that are engaged with the avoidance of oxidative harm, for example, glutathione peroxidase.[19] Health benefit applications of *T. versicolor* involves antibacterial, anti-inflammatory activity, antioxidants, anti-cancer, antiviral, cardiovascular tonic, cholesterol regulation, hepato-tonic, immunity boosting and renal tonic activities. Anticancer Activity for breast, cervical, throat, gastrointestinal tract, blood, hepatic tissue, pleural cavities, lymphoma, melanoma and cancer of rectal/colon and skin have been accounted for with utilization of *Trametes versicolor*. Reports have suggested antiviral activities of *T. versicolor* against HIV and in contradiction of *Aspergillus* spp., *C. albicans, E. coli,* and *Plasmodium* spp.

Fight against cancer

Though turkey tail mushrooms have a range of effects on the body, it's mainly noted for its work as a cancer treatment, treatment for relieving the effects of cancer therapies and its effect on the immune system. These impacts make it a great option when you're dealing with an illness that suppresses your immune system or when it can be otherwise overwhelmed, such as human papilloma virus or HPV, which can lead to cervical cancer, or as a complementary therapy for chemotherapy to build the immune system back up after a course of treatment to prevent secondary infections.[8,13]

In 2020, 1,806,590 new cancer cases were projected, with over 1/3 of those cases leading to the death of the patient. It's a terrible disease, one that's hard to fight, but as science expands to include more of nature's pharmacopeia, we can improve survival rates, both short-term and long-term. Using turkey tail mushrooms to help fight cancers in the digestive tract as well as breast cancer can help with this fight by directly attacking tumour. Japanese patients suffering from this terrible disease are commonly treated with the polysaccharides K (PSK) and P (PSP), with studies showing significantly stronger survival rates.[8,12] Another study has shown a 9% increase in 5-year survival rates, showcasing the medicinal mushroom's ability to give cancer patients more time with their loved ones. This is just part of the reason why it's been used as a complementary therapy in Asia for over three decades. In addition, the immune-boosting effects of turkey tail mushroom make it a popular treatment following a four-week chemotherapy course. This helps reduce secondary infections that can arise so easily following chemotherapy. In fact, the US Food and Drug Administration has conducted clinical trials, providing turkey tail extract to patients with advanced prostate cancer being treated with chemotherapy, as well as women with breast cancer, a process rarely seen with natural remedies. Turkey tail mushroom is especially effective in reducing the effects and severity of digestive-tract cancers, such as gastric, colon and colorectal cancers, even targeting cancer stem cells earlier than other treatments currently available, but has also been shown to be effective against at least specific types of breast cancer.[10] Kaposi's sarcoma, a type of skin cancer that is quite typically found in AIDS/HIV patients, has also been studied with the use of a variety of East Asian medicinal mushrooms, with turkey tail proving its worth as both an immune-boosting compound as well as an anti-cancer agent.

Immune-boosting effects

The turkey tail mushroom supports the immune system in three different ways: by boosting bone marrow production, which in turn boosts white cell production; by its solid antiviral properties that help the body fight off the common cold, influenza and even HPV, the virus which is the precursor to cervical cancer; and by modulating the immune system as a whole, boosting it when it's most needed while keeping it from getting out of hand and turning into an autoimmune disease.[17] But how do turkey tail mushrooms have this effect on the body's immune system? It's linked to botanical compounds that stimulate the immune system, including PSK and PSP. Other compounds within the mushroom boost the body's cytokine response, an important but minuscule protein that has shown strong effects on this specific immune function in animal studies.[4]

Digestive benefits

In addition to helping prevent digestive-tract cancers, turkey tail mushrooms also help improve the digestive tract as a whole by providing vital prebiotics to the body. These compounds nourish your existing gut bacteria to improve your body's natural flora to reduce the severity and occurrence of digestive-tract problems. It's been

found to be especially beneficial in patients with leaky gut syndrome.[14,15]

Cardiovascular effects

Turkey tail can also lower cholesterol, though the exact mechanism of this benefit is not yet fully understood. It may be that the mushroom's lack of cholesterol naturally helps lower the compound, but it's just as likely that the benefit comes from having a healthier digestive tract that prevents as much cholesterol from being picked up by the bloodstream and neurons.[18]

Diabetes improvements

The turkey tail mushroom may provide a solid option for treating high blood sugar. In several animal studies, lower glucose levels were found in the blood of patients with diabetes, which helped keep blood sugar under control. It also helps boost weight gain in patients who have issues with this due to their diabetes.[6,7]

Anti-inflammatory effects

The turkey tail mushroom can also reduce inflammation both internally and externally, which it manages by moderating the response of pro-inflammatory cytokines, an important part of immune function. This benefit is especially strong in individuals suffering from colitis, which causes inflammation in the bowel, which turkey tail is especially effective in treating. Some of these effects can even help promote weight loss.[18]

Gut Health Benefits

The constituents of *T. versicolor* are known to have benefits in improving gut health. Fibres of mushrooms in general especially *T. versicolor* fibre is indigestible portion of plant foods that increases digestion to maintain health.[15] Reports have suggested *T. versicolor* to deliver other benefits, such as:

Healthy gut bacteria

Exploration reveals that partaking a solid province of microbes in the gut can assist forestall sickness and backing the resistant framework facilitating immunity. *T. versicolor* might be useful to maintain equilibrium of microscopic organisms of gut that improves health. Investigations have suggested that PSP of *T. versicolor* possess prebiotic properties to assists the gut by controlling its equilibrium of microorganisms. Prebiotics are a sort of fiber which goes about as a food source for healthy gut micro-organisms.[15] Furthermore, proof demonstrates PSP in controlling the gut miniature biome to adjust levels and maitainance of healthy microscopic organisms in digestive tracts especially intestine.

Control on Obesity

Restricted examination recommends that protein-bound beta-glucan (PBG) present in *T. versicolor* could prevent and control obesity. An investigation in mice, for instance, the study shows that PBG prevented weight acquire in those who consumes a higher fat contents. The investigation also states that PBG helps to equilibrate certain micro-organisms in the gut that helps to prevent obesity. However, affirming it's impacts in people requires more examination and research.

Other Potential Benefits

Beyond their studied immune-boosting effects, turkey tails are currently in clinical testing to determine the efficacy of a wide range of health conditions. Recent studies suggest the following additional benefits:

Increased endurance – A 2017 study recorded increased stamina and decreased post-exercise fatigue in test subjects.

Antibiotic properties – A 2017 study found that turkey tail extract inhibited the growth of two bacterial strains, *Staphylococcus aureus* and *Salmonella enterica*. Turkey tail mushrooms are frequently used to battle infections, including those associated with influenza or the common cold. They can do more than this, however. They are powerful against Gram-positive and Gram-negative pathogenic bacteria like golden staph (*Staphylococcus aureus*), a well-known antibiotic-resistant strain of bacteria currently plaguing hospitals, nursing homes, and other healing environments. Turkey tail is effective because of its abundance of antioxidants and polysaccharides, which link up with the proteins and cell walls of bacteria, disrupting microbial membranes and inhibiting energy metabolism in the bacteria. This effectively creates havoc for the pathogen and kills it.[19]

Antiviral properties – Another 2014 study focused on turkey tails' effect in controlling symptoms of a chronic virus. 88% of people in the study experienced reduced symptoms. Several studies have found that PSK has anti-viral action. It has been used for its ability to inhibit HIV (human immunodeficiency virus, the virus associated with AIDS). Turkey tail mushroom has also been found to be beneficial for HPV (human papillomavirus, a sexually-transmitted infection) in preliminary clinical trials.[20] *T. versicolor's* polysaccharide peptide (PSP) have immunomodulatory properties to stimulate an innate immunogenic response using Toll-like receptor 4 (TLR4) with immaterial toxicity. Result suggests that PSP has anti-HIV activity arbitrated by TLR4 as important antiviral chemokines. These

molecular mediators might disclose further drug targets to unspoilt novel therapeutic opportunities for HIV-1 infection.

CONCLUSION

Studies regarding the content of individuals' compounds to prove use of *T. versicolor* as a source of phytochemicals with significant pharmacological effects are helpful in the development and discovery process of new drugs. Medical advantage applications leave a gap to advance with contemplates that enhances to address medical condition just as comprehend the components by which these bioactive components influencing the therapy of various kinds of diseases. Taking everything into account, the survey upholds the possible utilization of *T. versicolor* as promising mushroom with a good source of bioactive products for health benefits and also imperative applications in pharmaceutical industries.

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