TURKEY TAIL

Trametes versicolor (L.) C.G. Lloyd

Family

Polyporaceae, a large family of bracket fungi characterised by their shelf-like fruiting bodies and porous undersurfaces as opposed to gills. Relevant Latin synonyms that may be used in older literature include *Coriolus versicolor, Polyporus versicolor* and *Polystictus versicolor*.[1,2]

Parts Used

Fruiting body

Description

Turkey tail is among the most common woodland fungi in temperate forests worldwide, including throughout Australia. It prefers humid surroundings and occurs in overlapping clusters on dead and decaying hardwood logs and stumps, fallen trees and sometimes on living trees. Turkey tail's prolific growth on dead and decaying wood serves an essential ecological function as a decomposer of lignin (a complex polymer found in the cell walls of wood) returning nutrients to forest ecosystems. Turkey tail is so named because of its bright and intricately patterned crowns that are formed in the process while the mushroom grows, providing it with its distinctive turkey tail-like appearance. The thin (*Trametes*), fan-shaped caps (2-10cm in diameter) are covered in concentric rings that range in vibrant colour from varying hues of brown, orange and blue to green (occurring on older mushrooms where algae have settled), pink and purple hence the specific epithet *versicolor*. The wide range of colour variations of this attractive and durable fungus has made it highly valuable. At one time it was even

used to decorate hats. Turkey tail has a velvety feel on top while the underside and edge will always be white or cream in colour. They grow all year round, often remaining attached to their substrate through multiple seasons. Their tough, leathery texture makes them unpalatable for culinary use despite their lack of toxicity. They have, however, been suggested to be used as a substitute for chewing gum.[3,4]

Sustainability

No known sustainability issues. Our mushroom raw material supplier takes great care in sourcing their mushrooms to ensure both quality and sustainability. Their mushrooms are not wildcrafted as they believe this practice can harm natural ecosystems when done without proper regulation. Uncontrolled harvesting can lead to habitat destruction, depletion of species and disruption of local biodiversity. At the same time, their mushrooms are not lab-grown because this method does not produce the same medicinal potency. Lab-grown mushrooms are often cultivated on grain-based substrates which lack the complex nutrients found in a natural environment, leading to a lower concentration of key active compounds. Instead, they use wood-grown mushrooms, cultivated on natural hardwood in well-maintained, sustainable environments. This method closely mimics the way mushrooms grow in the wild but under controlled and ethical conditions. Wood-grown mushrooms develop their full medicinal potential as they absorb the rich nutrients from hardwood, as well as the local environment in terms of air quality, humidity and many other geological phenomena. This technique results in a higher quality and more potent product. This approach allows them to standardise the quality while ensuring that their practices remain sustainable and environmentally responsible.[5]

Traditional and Empirical Use

A revered tonic in traditional Chinese medicine (TCM), turkey tail has gained recognition in modern times for its remarkable ability to balance the immune system by both enhancing a weakened response and regulating an overactive one. Its most significant application has been in the field of oncology, where it is valued for its immunomodulating properties.[6,7,8]

Turkey tail is referred to as *yun zhi* in TCM, meaning 'cloud-like mushroom' because of its unique, undulating and fan-like shape, which resembles swirling clouds, or possibly due to the fluff that covers its surface. In Japan it is known as *kawaratake*, which has two meanings: 'mushroom by the river bank', a fitting name that reflects its natural habitat in moist humid, forested areas, and 'roof tile fungus', which directly refers to the way the mushrooms grow in overlapping, shelf-like formations similar to tiles on a roof. TCM has utilised hot water extracts (including soups) of the whole fruiting body for centuries, primarily as a tonic for strengthening the lungs, spleen and liver, for dispelling 'dampness' and 'phlegm', for anorexia, fatigue, lack of strength, influenza, the common cold and stomach issues. The Japanese have incorporated it into their traditional medicine system for supporting immune function and overall vitality. Empirical use in Western herbal medicine began in earnest during the late 20th century following Japanese research into its immunomodulating properties. The Chinese and Japanese have been using it as immune support therapy for cancer and Paul Stamets, an American mycologist and entrepreneur, claims to have cured his own mother of breast cancer using this mushroom.[9,10,11,12,13]

Constituents

Polysaccharides including beta-glucans, polysaccharide-krestin (PSK) and polysaccharide-peptide (PSP), sterols (cerevisterol), phenols (vanillic acid, viridoside and benzoic acid derivatives), flavonoids, triterpenoids (oleanolic acid, friedelin, glutinol, ursolic acid, corosolic acid, esculentic acid, lupeol and betulinic acid), sesquiterpenoids (coriolin), ribonucleotides (dihydrouridine, deoxyuridine), glycosides (ethylglucopyranoside, nigerose and trehalose) and furans (methoxyfurfural).[14]

The vast majority of turkey tail cited studies use either standardised extracts PSP or PSK, two constituents of turkey tail mushroom which are commonly used in place of the whole mushroom. PSP and PSK are highly refined extracts derived from pure mycelium (the filamentous part of the mushroom that grows through the soil) grown on nutrient liquid solutions (submerged cultures) that produce a mycelial mass with no other substrate

or organisms present in the finished product. The glucans, protein-bound glucans and other non-starch polysaccharides are then highly purified by a series of extraction steps that involve alkaline solutions. Because of this, results from studies that utilise these extracts are not directly transferable to the use of crude turkey tail mushroom or mycelium extracts. PSP and PSK studies are included in this monograph because there is a dearth of whole turkey tail human studies. PSK (or Krestin®) was developed in Japan in the 1960s and is a soluble protein-bound polysaccharide derived from the CM-101 strain of the fungus. Production of Krestin was discontinued in Japan from September 2017 but similar products are still available. PSP was developed in China in the 1980s and is a polysaccharide-peptide derived from the COV-1 strain. The molecular weights of the two preparations and the biochemical compositions are similar, but not identical.[15]

PSK and PSP have been shown to have immunomodulatory and anticancer effects. These active, high-molecular-weight complexes are the most-researched medicinal fungi products worldwide, with many clinical trials (at least 37 trials have been conducted on the protective effects of PSK) and *in vivo* and *in vitro* research studies published. Beta-glucans are by far the most widely characterised and studied fungal components of PSK and PSP. PSK has been shown to restore immune systems depressed by chemotherapy to normal levels in animal studies and has been reported to improve survival in clinical studies. PSK is also reported to attenuate the adverse reactions induced by chemotherapy or radiotherapy, including neutropenia (the presence of abnormally few neutrophils in the blood leading to increased susceptibility to infection). Similar effects are reported for PSP. Results of clinical trials in China indicate reduction in chemotherapy-induced adverse effects, including vomiting, and restoration of chemotherapy-induced immunosuppression when PSP was used in combination with cytotoxic agents. Such findings suggest that these extracts have the potential to improve tolerance to chemotherapy and radiotherapy and to reduce adverse effects due to depressed immune function. Both products also appear to have anti-tumour properties, which may contribute to an overall effect on survival. Specific mechanisms considered to be involved include production of antibodies and cytokines, and improved activity of natural killer cells, T cells, macrophages and peripheral blood lymphocytes.[16]

In herbal practice the method of preparation is key. According to herbalist, researcher and mushroom expert Christopher Hobbs, for maximum efficacy mushroom medicine is best delivered via water-based extracts or micropowders. He says these methods are preferred over alcoholic extracts because beta-glucans and proteins do not dissolve in alcohol, and alcohol disrupts hydrogen bonding, altering their tertiary structures enough to reduce immunomodulatory activity. Consequently, he does not recommend tinctures for managing immune disorders, cancer or viral syndromes. He does say that some mushrooms contain low molecular weight compounds, such as turkey tail's triterpenes, that demonstrate sedative, antiallergic, hepatoprotective and other beneficial activities. These compounds are alcohol soluble making tinctures a potentially useful option in those cases.[17]

The Herbal Extract Company made a deliberate choice to make a hydroethanolic extract capturing the complete phytochemical profile of turkey tail. This process not only extracts some polysaccharides but also captures ethanol-soluble compounds (such as triterpenes) that contribute additional benefits such as hepatoprotective effects. This provides a full-spectrum extract that embraces the complexity of the mushroom containing a diverse array of compounds rather than just isolated polysaccharides. While PSP/PSK studies provide important insights, the synergy of multiple constituents in a full-spectrum extract may offer complementary or even enhanced benefits that are not captured by studies focusing solely on water extracts. Enhancing the inherent synergy of the whole mushroom, rather than isolating specific compounds, aligns with holistic herbal principles. Both extraction methods have merit, however the Herbal Extract Company's approach is designed to deliver a broad spectrum of beneficial constituents in a form that remains true to the whole mushroom's integrity.

Actions

Immunomodulator, antioxidant, prebiotic, anti-inflammatory, antimicrobial, adaptogen, hepatoprotective

Pharmacological Activity

Owing largely to their use with cancer patients, turkey tail mushrooms are one of the most extensively researched of all the medicinal mushrooms. Many studies investigating the potential medicinal benefits of turkey tail have been conducted using animal models or in lab settings. More clinical research is needed to determine the specific uses of turkey tail for human health. This monograph will focus on human studies where possible.[18]

Many clinical trials exploring turkey tail's potential benefits for oncology were conducted in China and Japan from the 1960s to 1990s, the period where PSP and PSK became licensed pharmaceuticals and were routinely used as adjuncts to conventional cancer therapy in these countries, respectively. In a landmark 1994 paper, Japanese researchers found that administering PSK in addition to standard chemotherapy treatment "offers significant advantages in survival over chemotherapy alone for patients with curative resections of gastric cancers."[19]

PSK and PSP appear to increase the immune system's response to cancer cells, in particular solid tumours, and clinical trials have yielded positive results when administered alongside conventional treatments for stomach, colorectal, lung, oesophageal, nasopharyngeal, breast, cervical and uterine cancers. Beta-glucan (polysaccharide)-rich mushrooms such as turkey tail may support recovery from radiotherapy and chemotherapy by increasing diminished blood cell counts and bone marrow activity.

Immunomodulating and anticancer activity

Clinical trials have shown that consumption of turkey tail extracts, especially PSP and PSK, as an adjunct to standard cancer treatment can improve outcomes, such as survival rates, in people experiencing a number of different cancers. These include but are not limited to colorectal cancer, breast cancer, gastric cancer, oesophageal cancer and non-small cell lung cancer. PSK has been used as adjuvant therapy in thousands of cancer patients since the mid-1970s. It has been safely used in people for a long time in Japan and few side effects have been reported.[20]

Turkey tail is frequently used by herbalists and physicians to help mitigate the side effects of chemotherapy and radiation, such as anorexia, fatigue and pain, thereby speeding up overall recovery. Research indicates that PSP enhances quality of life for patients undergoing chemotherapy, enabling them to better tolerate treatment and potentially prolonging survival. Additionally, one clinical study found that adding PSK reduced chemotherapy-induced bone marrow suppression and peripheral neuropathy, while turkey tail may also offer protective benefits for immunocompromised individuals receiving standard cancer therapies.[21,22]

Several published systematic reviews have focused on turkey tail and its extracts. One meta-analysis published in 2012 focused on the effects of turkey tail on survival in cancer patients and concluded that there was strong evidence of a beneficial effect on survival, particularly in breast, gastric and colorectal cancer patients. However, only research published up to 2003 was included. A second meta-analysis focused on the efficacy of PSK for survival of patients with curatively resected colorectal cancer. PSK used as an adjuvant to conventional chemotherapy improved overall and disease-free survival, but risk of bias and adverse events were not addressed.[23]

A 2019 systematic review of 23 randomised clinical trials (RCTs), involving 4,246 people, into the use of both turkey tail and reishi products as adjuncts to cancer therapies concluded that these products may add to the quality of life and survival benefits in cancer patients.[24]

A 2000 review of earlier studies concluded that "their extremely high tolerability, proven benefits to survival and quality of life, and compatibility with chemotherapy and radiation therapy makes [PSK and PSP] well suited for cancer management regimens" (but multiple studies now show turkey tail to be an effective anti-cancer treatment, in addition to its long-term traditional medicinal use.)[25]

A U.S. Stage II clinical trial is currently underway exploring the use of a variety of complementary medicines in reducing surgical adverse events and raising the quality of life and survival rates of patients undergoing surgery for thoracic (lung, gastric and oesophageal) cancers. Turkey tail (1.5g) will be given twice daily alongside a number of other

complementary medicines and nutrition, exercise and psychological recommendations.[26]

Turkey tail's immunomodulatory properties have traditionally been employed to support individuals with autoimmune conditions such as rheumatoid arthritis. In a preliminary trial involving patients with systemic lupus erythematosus, administration of PSK was associated with symptom improvement, although further research is needed to confirm these findings.[27,28]

Gastric cancer

Studies show that the use of PSK as adjuvant therapy in patients with gastric (stomach) cancer may help repair immune cell damage caused by chemotherapy and strengthen the immune system. An RCT in Japan done between 1978 and 1981 included 751 patients who had surgery for gastric cancer. After surgery, patients received chemotherapy with or without PSK. On average, the patients who received chemotherapy and PSK lived longer than those who received chemotherapy alone. The researchers believe it might be possible to predict which patients would benefit the most from PSK depending on the numbers of granulocytes and lymphocytes in the patient's blood.[29]

A meta-analysis published in 2007 combined results from eight RCTs in 8009 patients who had surgery to remove gastric cancers. After surgery, patients in the trials were given chemotherapy with or without PSK. The results suggest that receiving chemotherapy and PSK helped patients live longer after surgery.[29]

In 1994, a study in Japan followed 262 patients who had successful surgery for gastric cancer and were given chemotherapy with or without PSK. Patients who received chemotherapy and PSK were less likely to have recurrent cancer and lived longer than

those who did not. Treatment with PSK caused few side effects. The researchers thought the study showed that PSK and chemotherapy should be given to gastric cancer patients after surgery to remove the cancer.[31]

Breast cancer

To date, PSK studies in patients with breast cancer have focused on changes in the immune system (T-cell and B-cell levels in the blood) rather than on clinical results (patient survival, symptoms, side effects and quality of life). In one early study freeze-dried mycelial powder was obtained from Paul Stamets. Each capsule contained 500mg of product. The findings of the Phase 1 clinical trial showed that up to 9g a day of the turkey tail preparation had improved immune status compared with those receiving standard care (surgery, chemotherapy and radiotherapy) alone.[32]

Colorectal cancer

Clinical studies of PSK in colorectal cancer have shown reduction in recurrence and improvement in overall survival with adjuvant use. PSK was studied in a randomised clinical trial for its effect on the immune system in patients with stage II or stage III rectal cancer. Patients received chemotherapy and radiation therapy, with or without PSK. This study found that PSK increased the number of cancer-killing immune cells and had anticancer effects in tissue that received radiation therapy.[33]

A review that combined results from three studies in 1094 patients with colorectal cancer found that patients who received PSK were less likely to have recurrent cancer and lived longer than those who did not.[34]

Two groups from Japan studied patients with colorectal cancer who received adjuvant chemotherapy with or without PSK after surgery. In the first study, patients who were treated with both chemotherapy and PSK had markedly better 10 year survival rates. In the second study of patients who were older than 70 years, three year survival rates were markedly higher in the group treated with both chemotherapy and PSK.[35]

Lung cancer

Five nonrandomised clinical trials reported that patients treated with PSK and radiation therapy with or without chemotherapy lived longer. Six randomised clinical trials in patients with lung cancer studied chemotherapy with or without PSK. The studies showed that patients who received PSK improved in one or more ways, including immune function, body weight, well-being, tumour-related symptoms, or longer survival.[36,37]

Antioxidant activity

Several of the compounds in turkey tail are powerful antioxidants, substances that help reduce oxidative stress in the body. Oxidative stress can lead to organ and tissue damage. Antioxidants counteract the free radicals that cause this damage. The antioxidants present in turkey tail include polysaccharides, ergothioneine, krestin, sterols, terpenoids, phenolic compounds and melanin. These molecules help to protect the immune system by reducing inflammation and activating immune cells. They also help maintain healthy gut bacteria, may improve cognitive function and reduce the risk of age-related cognitive decline. More research is needed to see turkey tail's direct impact on cognitive function.[38]

Antimicrobial activity

Based on its traditional use for reducing dampness and clearing phlegm, turkey tail is valued for both preventing and soothing colds, flus and other respiratory infections. Herbalists also employ it to accelerate recovery from pneumonia and bronchitis, as well as to support those with asthma. This traditional use is supported by two human clinical trials from 1979. These studies demonstrated that consumption of PSP from turkey tail not only reduced coughing, phlegm production and breathing difficulties but also enhanced innate immunity in patients with chronic bronchitis.[39,40]

Turkey tail may be helpful as an anti-viral aid and has shown promising results in treating herpes simplex virus (HSV), HIV, human papillomavirus (HPV) and chronic fatigue syndrome with a high viral load. A preliminary randomised clinical trial found administration of a combination of turkey tail and reishi for two months in patients positive for oral human papillomavirus-16 or -18 produced a clearance rate of 88%, compared to just 5% in those consuming another mushroom *Laetiporus*

sulphureus.

A 2021 randomised controlled trial, involving 91 women, explored the use of 3g per day of Papilocare, a turkey tail mycelial biomass based vaginal gel (which contains other ingredients including hyaluronic acid, gotu kola and *Aloe vera*), in healing HPV-related low-grade cervical lesions. It found there was a significant increase in normal pap smears and colposcopies after three and six-month periods as compared to the control group. This was especially true for women in the high-risk group (those whose lesions were at the greatest risk of leading to cervical cancer). The cervical re-epithelisation score was also significantly higher in the treatment group. Larger Papilocare studies are currently underway.[43]

Gut health

Rich in heavy weight polysaccharides that serve as prebiotics, turkey tail water extract has been found to have a beneficial effect on the composition of intestinal microbiota. This prebiotic effect may underlie many of its systemic benefits, given the gut microbiome's influence on immune function. In one small older study from 2014, 24 participants were given 3600mg of turkey tail PSP extract per day over eight weeks. Results showed that turkey tail extract had a regulatory, prebiotic activity on the intestinal microbiome, increasing the number of beneficial bacteria and suppressing the growth of potentially harmful bacteria. The author's speculated that while PSP might directly act as a prebiotic by altering the microbiota due to its immunomodulatory properties, it may also modify the microbiome indirectly by triggering host responses that, in turn, reshape microbial composition. More research is needed to determine whether PSP or turkey tail extract can modulate microbial populations, particularly in vulnerable scenarios such as aging, during or after antibiotic therapy, in states of immunosuppression, or when oral nutrition is impaired. Such future findings could provide valuable insights into the potential of turkey tail extract to repair damage caused by antibiotic use.[44]

Cardiovascular activity

Turkey tail and its extracts may help improve blood lipid profiles. In a 2007 study involving 240 individuals with hyperlipidaemia, consumption of PSP alone significantly reduced total cholesterol, LDL and triglyceride levels compared to the control group.[45]

Hepatoprotective activity

Turkey tail extracts have been shown to support patients with chronic liver disease, including drug-induced hepatitis and chronic viral hepatitis. Whether used on its own or in combination with interferon therapy or other TCM herbs, PSP has improved recovery of key liver enzymes, enhanced the development of antibodies against hepatitis B virus, reduced viral load and increased hepatitis B 'e' antigen (HBeAg) seroconversion rates, a marker indicating a less infectious disease state.[46]

Indications

- Immune support in individuals with compromised immunity, autoimmune or allergic conditions and during and after cancer treatment.
- Adjunctive cancer therapy: Used alongside conventional treatments to reduce side effects and improve outcomes in cancers such as gastric, colorectal and breast cancer.
- Recurrent and chronic infections: Chronic viral infections, recurrent respiratory infections.
- Chronic fatigue and post-viral syndromes.
- Inflammatory bowel conditions including ulcerative colitis and Crohn's disease.
- Hepatic support: For toxic exposure or recovery from hepatitis.

Energetics

Turkey tail affects the lungs, liver and spleen and is sweet and slightly warm, therefore, nourishing and strengthening in cases of debility. It is also slightly bitter meaning it 'directs downwards'; promoting the draining of dampness from the body and calming cough by redirecting 'rebellious' lung qi. In TCM the temperature classification of turkey tail is debated. Some sources describe it as slightly warm, while others classify it as slightly cool. Sweet and slightly warm aligns with its traditional use in supporting qi deficiency and enhancing immune function. Warm herbs tend to nourish and strengthen, making this

classification logical for a herb used in cases of debilitation, immune weakness and chronic illness. Some sources categorise turkey tail as slightly cool due to its ability to clear dampness and heat, particularly in the liver and spleen. In TCM bitter herbs often have a draining, cooling effect, which could explain this classification. The consensus in practice is that turkey tail is neutral to slightly warm, but its function can appear cooling due to its dampness-draining and detoxifying actions.[47]

Use in Pregnancy

Insufficient reliable information available so avoid using.[48]

Contraindications and Cautions

Orally, turkey tail and its PSK component are generally well tolerated. There have been reports of gastrointestinal side effects, haematological abnormalities, liver dysfunction and palpitations, but these are in patients who received PSK in addition to standard chemotherapy. It is not known if these are due to PSK, the chemotherapy, or both.[49]

Drug Interactions

Few significant drug interactions have been documented with turkey tail although theoretical considerations include:

Caution with antidiabetic medications. Theoretically, taking turkey tail with antidiabetic drugs might increase the risk of hypoglycaemia. Animal research suggests that turkey tail and a polysaccharide component can have hypoglycaemic effects.[50]

Caution with immunosuppressants. Theoretically, the PSP component of turkey tail might increase exposure to cyclophosphamide. Some animal research shows that the PSP component of turkey tail can increase the area under the concentration-time curve (AUC) of cyclophosphamide. This interaction could potentially increase the effects and adverse effects of cyclophosphamide. However, it is not known whether PSP affects the levels of the active metabolites of cyclophosphamide that are responsible for its clinical activity.[51]

Caution with selective estrogen receptor modulators (SERMs). Theoretically, the PSP component of turkey tail might interfere with the absorption of tamoxifen. Animal research suggests that PSP increases the time to reach maximum concentration of a single dose of tamoxifen by about 9.5 hours. When repeated doses of tamoxifen were given, the time to reach maximum concentration was increased by about 5.6 hours. However, PSP did not affect the maximum concentration or the area under the curve of tamoxifen.

Administration and Dosage

Liquid Extract:	1:5
Alcohol:	30%
Weekly Dosage:	35 to 80mL[52]

Clinical Tips for Practitioners

Immune support in chronic infections

Use turkey tail as part of a formula for patients recovering from chronic or recurring viral infections (e.g. EBV, HPV, HSV). Its polysaccharide content, particularly beta-glucans, modulates immune responses and enhances natural killer cell activity.

Respiratory health

Useful in formulations for patients with chronic respiratory conditions, particularly where immune modulation and reduced inflammation would be beneficial.

Adjunct in cancer support

Use as adjunctive care during conventional cancer treatments (especially for patients undergoing radiation or chemotherapy) to potentially reduce side effects, support immune function and improve quality of life. Particularly studied in breast, colorectal and gastric cancers. Ensure alignment with the oncologist and use only in supportive, not primary, roles.

Gut microbiome support

Consider for patients with dysbiosis, inflammatory bowel conditions or post-antibiotic gut repair, as the prebiotic properties of turkey tail support beneficial gut bacteria and may help restore intestinal barrier function.

Detoxification support

Include in protocols for patients undergoing environmental detoxification as turkey tail may support liver function and help clear metabolic waste.

Safe for long-term use

Turkey tail is generally well tolerated and safe for extended periods. This makes it ideal in chronic conditions requiring ongoing immune vigilance (e.g. Lyme recovery, autoimmunity in remission).

Combine synergistically

For immune synergy pair with:

- **reishi** for broader adaptogenic support
- **astragalus** for enhanced resistance in immunocompromised or elderly patients
- **elderberry** for acute viral infections with specific antiviral support
- **echinacea** for acute immune activation alongside turkey tail's more tonic effects
- **liquorice** for harmonising effects, adrenal support and additional anti-inflammatory action
- **cordyceps** for enhanced energy and lung support alongside immune benefits
- **lion's mane** for combined immune support with neurological and cognitive benefits, particularly valuable in neurodegenerative conditions with immune dysregulation

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