

Yun Zhi Polysaccharopeptide (PSP) and the general aspects of its research

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Originally published on *Fung. Sci.*, 12(1,2):1-8,1997. Adapted by author.

Introduction

Yun Zhi Polysaccharopeptide (PSP) is a new type of BRM (Biological Response Modifier) extracted from the deep layer cultivated mycelia of Cov-1 strain of [Yun Zhi](#) (*Coriolus versicolor*). Its active ingredient is a protein bound polysaccharide used in the BRM therapy of tumours. Its characteristics and the general aspects of its research are briefly introduced in this paper

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General aspects

Yun Zhi polysaccharopeptide is internationally known as PSP-polysaccharopeptide and essence of mushroom ([Yun Zhi](#)). The name PSP was first proposed by the author at the Appraisal Meeting of the Scientific Achievements of Yun Zhi polysaccharopeptide presided over by Shanghai Higher Education Bureau in January 1987. "PS" is the abbreviation for polysaccharide. The last letter "P" stands for the first letter of either protein or polypeptide. "PSP" means that it is a polysaccharide linked to a small molecular protein or polypeptide. The English name for polysaccharopeptide can be glycopeptide, proteoglycan or glycosaminoglycan, etc. However, the polysaccharide component of all these polysaccharopeptides is N-acetylhexosamine, which is different from that of Yun Zhi polysaccharopeptide. It is, therefore, inappropriate to use these names. Thus, we proposed a compound name for it -- "Polysaccharide-peptide". In 1989, the American Type Culture Collection (ATCC)

and the National Cancer Institute entered PSP in the list of "Anti-tumor and Anti-virus Substance of "Fungi", and suggested to combine polysaccharide and peptide into a single term - polysaccharopeptide. We originally used Ps-P for the English name of Yun Zhi polysaccharopeptide. A small letter "s" and a symbol "-" were inserted between the two capital letters "P". Due to inconvenience in typing, the abbreviation has been simplified to PSP since 1990. Yun Zhi polysaccharopeptide is applicable to all tumour patients undergoing surgery, chemotherapy or radiotherapy. Essence of Mushroom (Yun Zhi) is obtained by the further isolation of the crude product of Yun Zhi polysaccharo-peptide. Its harmful ingredients: Hg, Pb, Cd, As₂O₃, etc., comply with the standard of food hygiene. Yun Zhi polysaccharopeptide is applicable to the elderly people, the physically weak and those who overwork. It can invigorate vital energy and enable users to become more energetic and live healthier and longer. [Back to top](#)

[PSP is derived from but is superior to wild strains of Yun Zhi](#)

The fungus used for the production of PSP is the traditional Chinese herb - Yun Zhi. According to the herbal literature of many dynasties, Yun Zhi belongs to a type of Zhi. In Compendium of Materia Medica (Vol. 28) and Pictures of Collecting Zhi (A.D. 889-896), there are records of black and green Yun Zhi. For thousands of years, Yun Zhi has been considered to have the effect of supporting health and energy and strengthening physique, and benefiting spirit and vital energy. In modern mycological taxonomy, Yun Zhi belongs to polyporaceae Basidiomycotina. Its Latin name is *Coriolus versicolor* (L. ex Fr.) Quel. Its other names are *Polyporus versicolor* (L.) Fr. and *Trametes versicolor* (Fr.) Pil. There are over 120 strains of Yun Zhi recorded in the Compendium of Materia Medica. The strain Cov-1 used for the production of Yun Zhi polysaccharopeptide is obtained by careful and repeated selection and cultivation of over 80 wild strains of Yun Zhi collected from various parts of China, thus PSP derives from but is superior to wild strains.

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[The essence of Yun Zhi](#)

PSP is different from ordinary polysaccharides, for ordinary Yun Zhi polysaccharide are extracted from the fruitbodies of Yun Zhi. Their main component is glucan and they are primarily used for the treatment of acute and chronic hepatitis. Since the anti-cancerous ingredient of Yun Zhi- Protein bound polysaccharide- exists

primarily in the mycelia, PSP uses the deep layer cultivated mycelia as its raw material instead of using the fruitbodies. The Yun Zhi mycelia produced by modern biological engineering technology are not only pure but also of higher quality. PSP is not an ordinary Yun Zhi water extract. The extraction technology of PSP is unique in that its medicinal ingredients are isolated and purified from Yun Zhi. The yield of extraction is only 5%. Thus, PSP is absolutely the essence of Yun Zhi.

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The protein-bound polysaccharide that contains beta 1,3 glycosidic bond

The polysaccharopeptide of PSP is not an ordinary glucan. The determination of PSP with gas chromatography and HPLC has proved that in addition to glucose, PSP contains 5 other monosaccharides - mannose, xylose, galactose, rhamnose and arabinose.

When PSP is analyzed with gas chromatography and mass spectroscopy according to Hakomori method, PSP is found to contain a large number of 2, 4, 6 trimethyl glucose. It reveals that PSP contains 1,3 glycosidic bond.

The Infrared spectrum of PSP shows that there is an obvious absorption at 8.93 cm^{-1} of the characteristic vibration zone. In addition when PSP is analyzed with nuclear magnetic resonance spectroscopy, there are strong resonance signals at 5.4 ppm of the hydrogen spectrum and 90.35 ppm of carbon spectrum. All these studies prove that in PSP 1->3 glycosidic bond there exists beta connection. It is known that beta 1->3 glucan is the activator of the anti-cancerous immune system of the human body.

Sephadex gel chromatography, DEAE-cellulose column chromatography and HPLC reveal that the polysaccharide and peptide of PSP are closely bound and not separated. Where there is polysaccharide there is polypeptide. It shows that PSP polysaccharide is connected with a small molecular protein (polypeptide). A number of literatures works have proved that only those fungal polysaccharide that bound with protein can produce anti-tumor effect after oral administration to patients.

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A new type of biological response modifier (BRM)

Pharmacodynamic studies prove that PSP has a very obvious effect of strengthening health and energy to eliminate substances and is a new type of BRM

1. PSP can enhance the immune function of a normal body.
 - Promote the expression of IL-6 gene of peripheral blood lymphocytes (PBL) in humans and hence induce the production of interleukin 6 (IL-6), and also activate white blood cells to increase the production of interferon alpha and gamma by 2 to 4 times.
 - Greatly increase the phagocytic index and raise HC_{50} , IgG and PFC values in mice; accelerate PBL from G₁ to S period and promote the proliferation of PBL.

Promote the proliferation of T-lymphocytes and pre-T cells in the thymus and spleen.

2. PSP can antagonize tumour-induced immuno-suppression in animals

- Arrest the atrophy of thymus in sarcoma bearing mice.
- Antagonize the swelling of liver due to Ehrlich ascites carcinoma.
- Counteract the inhibition effect on antibody caused by sarcoma in mice.
- Raise the value of serum complement C₃ in sarcoma bearing mice.

3. PSP can antagonize immuno-suppression caused by chemotherapeutic drugs.

- Obviously antagonize the lowering action of white blood cells caused by cyclophosphamide and shorten the recovery time of WBC.
- Obviously counteract the inhibitory action of cyclophosphamide on interleukin-2 (IL-2) and NK cells.
- Restore the delayed type hypersensitivity (DTH) reaction inhibited by cyclophosphamide.

4. PSP can inhibit the growth of cancer cells in men and animals.

- PSP (50mg/kg, *ip* or *po*) can inhibit the growth of sarcoma 180 in mice. The inhibition rates are 46-68%.
- A test using radioactive precursors shows that PSP (100microgram/ml) can inhibit the synthesis of nucleic acid of Ehrlich ascites carcinoma. The inhibition rates of RNA and DNA are 51% and 45% respectively.
- PSP can inhibit the growth of P388 leukemia cells, myeloma cells, hepatoma, Lewis lung cancer in mice. It can also inhibit the growth of human liver cancer, colon cancer, nasopharyngeal carcinoma, stomach cancer, human lung adenocarcinoma, monocytic leukemia and human skin histiocytic lymphoma. It can also cause the swelling of cancer cells and chromosome aggregation
- That antilymphatic serum (ALS) can counteract the inhibitory effect of PSP on sarcoma provides counter-evidence that anti-tumour activity of PSP is related to the increase of T-lymphocytes.

5. Other effects of PSP.

- Obviously improve the appetite of mice being administered with cyclophosphamide.
- Obviously decrease the painful reaction of animal caused by hot plate, acetic acid and electric stimulation.
- Inhibit the central nervous system and decrease the spontaneous activity of mice.
- In terms of the survival time of mice in oxygen-lacking conditions, PSP test group has a much higher ability of anoxia tolerance.

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New medicine of national class

The random double-blind clinical trials (485 cases) have proved that PSP can obviously improve the clinical symptoms commonly occurring in cancer patients, for example, weakness, tiredness, poor appetites, pain, anxiety, insomnia, nausea, vomiting, spontaneous and night sweat. In addition, PSP can minimize the toxic and side effects caused by chemo-or radiotherapy, stabilize the white blood cell count, increase the activity of NK and LAK cells, reverse the CD₄⁺ /CD₈⁺ ratio and raise the value of Karnofsky evaluation. The total effective rate is 82.96%.

Yun Zhi polysaccharopeptide and its capsules were successfully approved by the Ministry of Health as "the first grade herb and the second grade clinical trial" in 1992. In June 1993, the Ministry of Health issued a new medicine certificate for PSP (Certificate No. 93) Health Medicine, Hygienic Medicine Certificate Z-32). In 1996, PSP got the second prize of Scientific and Technological Advancements awarded by National Education Commission. Up to the present, PSP is the only new Yun Zhi medicine of national class in China approved by the Ministry of Health to be used for the treatment of tumours.

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Green medicine for cancer treatment

The raw materials used for the fermentation and production of PSP are natural and of food grade. In the production process, no harmful ingredient is used. Toxicological experiments conducted by Shanghai Medical University, Shanghai Institute of Labour Health and Occupational Disease and Shanghai Institute of Materia Medica of Academia Sinica have all proved that PSP produces negative result in acute and chronic toxicity tests, genotoxicity or second generation teratogenic tests. Even given an oral dosage of 100 times the clinical dosage for six months, none of the dogs and monkeys shows abnormality in their organs such as heart, liver, lung, stomach, ovary and sperm. Another experiment giving guinea pigs a dosage of 100 times the clinical dosage also proves that PSP causes no adverse effect on the fertilization rate of the first and second generation.

PSP is different from ordinary chemotherapeutic drugs. Although its anti-cancer effect is not as that of potent as that of chemotherapeutic drugs, PSP does not cause harm to the normal cells. In other words, PSP possesses the ability of distinguishing between normal and cancer cells. Our famous oncologist Professor Liang-zhong Xu and toxicologist Professor Bao-zhen Zhong have discovered that PSP can cause chromatin aggregation in cancer cells of human lung cancer, stomach cancer, leukemia and lymphoma, but it does not produce any toxic effect on lung fibroblast. Dr. Mei-po Yang of University of Hong Kong has also proved that PSP can cause the burst and coarseness of the membrane of human liver cancer cells (SMMU-7721) but it does not produce such morphological changes or toxic effects on normal liver cells. There are tens of thousands of clinical application of PSP. Many patients have taken Psp consecutively for 9 years and neither adverse effect nor contraindication has ever been observed, Physicians make laudable remarks on PSP and consider it the green medicine for the treatment of tumours.

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PSP and PSK

Just the same as Japanese PSK (Krestin), PSP is a protein bound polysaccharide extracted from the deep layer cultivated mycelia of Yun Zhi strains and different fermentation and extraction methods (PSP uses Cov-1 strain and is extracted with alcoholic precipitation while PSK uses CM-101 strain, and is extracted with salting out with ammonium sulphate), their polysaccharide components and hence their curative effects are not entirely the same.

PSP contains rhamnose and arabinose, while PSK contains fucose. PSK has been postulated to possess anti-inflammatory function. In addition to anti-inflammatory effect, PSP has extra effects of relieving pain and improving appetite. According to the research of Ge (1987), the content of major anti-cancerous component of PSK-B component is lower than that of PSP. The Shanghai Institute of Materia Medica of Academia Sinica made a comparative study on the anticancerous effect of PSK and PSP on sarcoma-180, Ehrlich ascites carcinoma and P388 leukemia cells. The study showed that PSP possesses a more potent tumour inhibitory effect than PSK does. Under the same concentration, the inhibition rate of PSP on sarcoma-180 (ICR/JUCL mice, 50 mg/kg ip) is 43% while that of PSK is 28%, the inhibition rate of PSP(100 microgram /ml) on P388 leukemia cells is 90% while that of PSK is 61%, the inhibition rates of PSP on the RNA and DNA synthesis of Ehrlich ascites carcinoma are 47% and 65% respectively, while those of PSK are 39% and 34% . Furthermore, Dr. T. Willard of Canada has also reported that pharmacological activity of PSP is higher than that of PSK.

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Prize of distinguished patent of China

As a new type of BRM different from the Japanese PSK, the production technology of PSP is unique. The fermentation process takes only 64 hours, 3 times quicker than that reported in Japanese PSK patent. (PSK patent literature reports that PSK takes 10 days for fermentation). The production cost of PSP is only onetenth of that PSK. Moreover, PSP has more medicinal ingredients and higher pharmacological activities. In January 1987, PSP has passed the technical appraisal presided over by the famous oncologist Professor Zeng-yi Sun and others. The medical experts concluded that the successful research of PSP fills the blank of such kind of medicine in China and has great significance in the anti-cancerous immunological research PSP also breaks the monopoly of Japanese PSK and achieves the international advanced standard . In October 1987, PSP was awarded the silver medal prize at the Third National Invention Exhibition of China. In 1989, PSP obtained the invention patent (Patent No. 89105471.5). In 1996 it was awarded the prize of distinguished patent of China.

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New product of national class

The Yun Zhi polysaccharopeptide capsules are manufactured exclusively by Shanghai Xin-Kang Pharmaceutical Factory. The factory is a pharmaceutical enterprise newly established to meet GMP Guidelines. Over half of the staff have received higher education. Since 1993, the factory has been honoured with the title of "Shanghai High and New Technology Enterprise" by Shanghai Science and Technology Commission. The "Qing Kang" Brand Yun Zhi Polysaccharopeptide Capsules produced by Shanghai Xin-Kang Pharmaceutical Factory is of excellent Quality. Since its establishment, the factory has never produced defective products. In 1992, PSP was awarded the gold prize of "New Technology and New Product Fair of China". In 1995, it was conferred the "New Product of National Class 1994". Certificate by such organizations as National Science and Technology Commission and National Technology Inspection Bureau.

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International appraisal

PSP has won international attention and recognition as a new type of biological response modifier (BRM) from the academic and medical circles. A number of theses on the topic of the application of PSP have appeared in the journals of various disciplines such as immunology, microbiology, Chinese herbal medicine, clinical pharmacology, pathology and oncology.

Two international symposiums for PSP had been convened in 1989 and 1993. PSP has been recorded as the only Yun Zhi anti-cancerous polysaccharide of China by American National Cancer Institute. In recognition of Professor Qing-Yao Yang's exceptional accomplishment in traditional Chinese medicine, he was awarded the Distinguished Achievement Award by the U.S. Chinese Medical Association in 1993. Up to the moment, there are only two Yun Zhi products recognized by the medical circles, one is Japanese PSK (Krestin), the other is Chinese PSP.

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