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A Review on Mushroom in Treatment of Cancer



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ABSTRACT

Mushroom are obtained from natural source it may contain different bioactive constituent so since ancient time it is use as immunomodulation and cancer curative agent. The regular intake of mushroom may useful for improvement human health. The largest population are death because of cancer disease. However, there is development of cancer treatment & research. And there is new drug development and therapy is available, but due to new drug development and therapy, dangerous side effect may cause to human body. Thus natural bioactive compound use as a immunomodulation agent and act as cancer supportive treatment in cancer therapy. The active component extract from medical mushroom may successfully use in treatment of cancer. The active constituent of mushroom may trigger immune system against cancerous cell. They block cellular signal transduction pathway which may act to prevent cancer growth & progression. In this review, we merge all available data based on medical mushroom which may use act as effective biological immunotherapeutic agent this review may consider as a future point of view and it may use as a potent medicament in cancer treatment.



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INTRODUCTION

Daily intake of mushroom cause increase in strength and may cure on different disorder occur in human body [1]. Mushroom contains some active component which may use as a medicine in cancer treatment. Since ancient time mushroom is use as an Ayurvedic medicament or medicine in many disease condition. Nowadays it is use in treatment of lung disease and cancer. In China and Japan more than 30 yr. accepted mushroom in treatment of cancer, it may use single or combination with radiation or chemotherapy.

Lots of mushroom available in Asia region like a *Ganoderma lucidum* (reishi), *Trametes Versicolor* or *Coriolus Versicolor* (turkey tail), *Lentinus edodes* (shiitake), and *Grifola frondosa* (maitake)[2].

There are many studies and work on how mushroom act or increase immune system and how they prevent or gradually decrease growth of cancerous cell& also on how to kill the cancerous cell. Turkey tail mushroom contain some medicated or chemical compound like polysaccharide which enhance immune system to attack on cancer & cell.

Nowadays in treatment of cancer surgery, radiation therapy, or chemotherapy is given. The choice of medicine or therapy is mainly depend on nature and condition of cancerous cell in body. In the treatment of cancer mainly radiation therapy and chemotherapy there may shows harmful/side-effect and also decrease strength or immunity of the patient which may cause seriously damage human health or make the human body more sensible to disease condition or disease attack so that person may suffer from different disease condition. Curing of patient from cancer has main aim that to enhance patient aspect of life & customize host against malignant infiltration

Mushroom contain large quantity of antioxidant, anti-diabetic, anti-microbial, anti-inflammatory, & also best source of immunomodulation property (3)

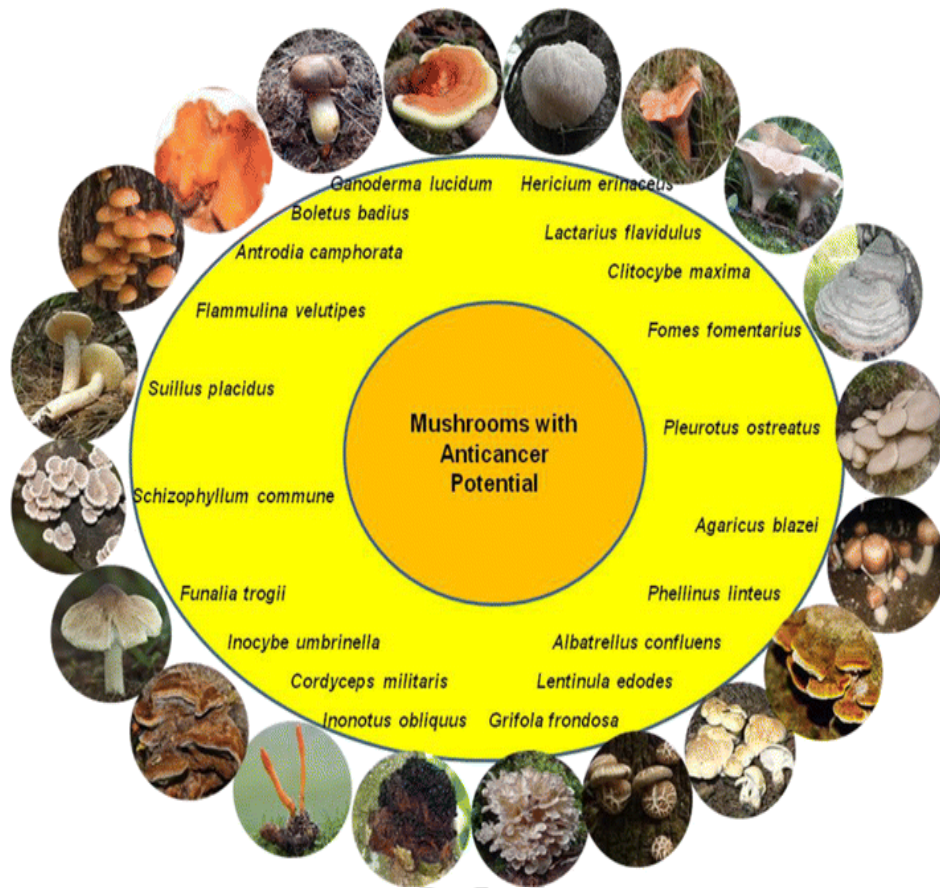


Figure No. 1: Mushroom in cancer treatment

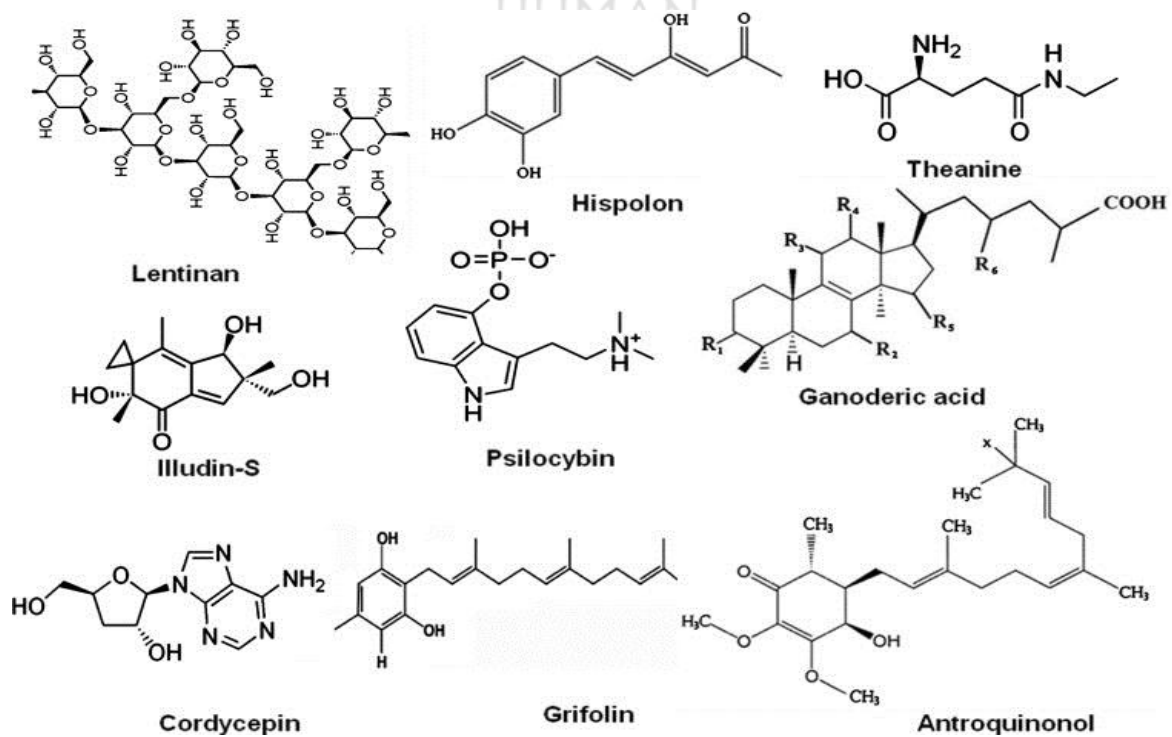


Figure No. 2: Structural representation of anticancer drug extract from mushroom

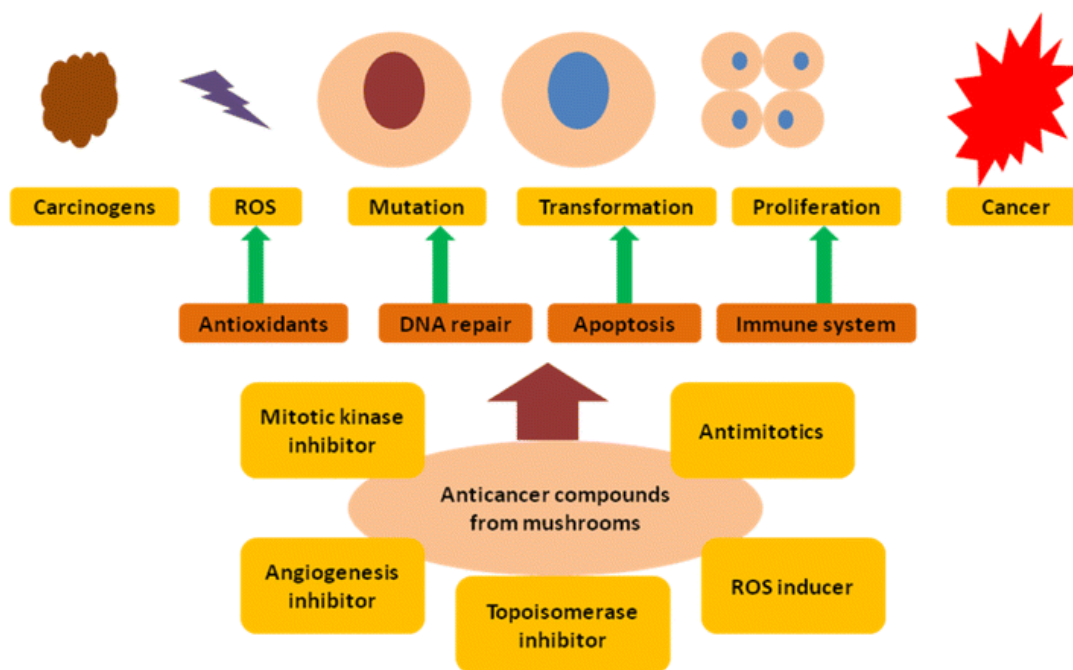


Figure No. 3: mechanism of action of mushroom on cancer

MUSHROOM SPECIES CONTAIN ANTICANCER PROPERTY

Phellinus Genus

Phellinus is a mushroom which shows anticancer activity having affinity to the *Hymenochaetaceae* class. *Phellinus* is also known as *Phellinus linteus* which shows anticancer, ant metastasis, & immunomodulation activity has been shown by this mushroom or this species [4]. This mushroom is mostly use in Australia. The fruit part of this mushroom when burn and the fumes when breath in use to treat in sore throat [5], anti-mutagenic activity shown by the abstract of *Phellinus linteus* may show activity against cancer by inhibiting growth of cancerous cell. This mushroom contains some phenolic group carrying compound like Hispolon which inhibit or prevent transformation of mutation to proliferation of the breast and bladder cancerous cell.[6] here apoptosis action is seen by this drug and arrest G2/M phase

The isolation of active component of this mushroom using methanol agent may act as a stimulate angiogenesis which act against inflammation & cancer/ tumour. The consumption of isolation of mushroom for 8 weeks may increase in count of T cell & induce in tumour size [7]. The acid polysaccharide present in this mushroom may cause increase NO₂. This may act on macrophage

Pleurotus

This mushroom is also known as pearl oyster mushroom it is mostly consumable mushroom. In world war, this mushroom was first grown in Germany. *Pleurotus* is a fungi obtained from the species of *p. ostreatus* belonging to family *pleurotaceae*. These mushroom commonly use/ consume in Japanese Korean dish. These drug mainly use in colon cancer when there is isolation of drug by using aqueous polysaccharide [8]. In preclinical trial this drug administered for more than 20 days at the dose of 5mg/kg to the tumour carrying mouse there is nearly 80% prevention of tumour growth in mice should be occur. When this drug isolated by using lectin may shows strong antitumor activity [9]. Mechanism of action of this drug is through apoptosis and prevents proliferation formation.

This mushroom contain low quantity of water soluble vitamin like B1, B2& C. it also contain minute proportion of lipid mainly cholesterol and it is rich in protein constituent so that it is mainly have different action and may also contain calcium. Soit mainly use in treatment of inflammation that is anti-inflammatory, in treatment of diabetes, as an antihypertensive and as an antioxidant. It is mainly reduce the effect adverse effect of most of the cancerous drug.

Agaricus

In 1970 it was first located in Brazil. Then it is located in east United States in late 19th and 20th. It is also grown up in japan and china. In Japan, this is mostly use in tea or it may consume in daily basis. *Agaricus* is a fungus which is also known as a field mushroom or meadow mushroom. *Agaricus* is a neutraceutical which has shown increase immunity of the human body [10]. There are two balance immunity enhancer that are *Agaricus Bisporous; lectin & Agaricus polytricha protein*. When there is isolation of active component from the Bisporous it may prevent procreation of breast cancer. The isolation of active constituent of *Agaricusblazei* shows extra use in tumour eradicator& anti leukemic. This mushroom also possess the other therapeutic action like adult onset of diabetes, lower the cholesterol level in body, it also cause softening of arteries, and also use in GI disorder,

It may also strong the bone of the human and also use in treatment of cardiovascular problem. It is also act as immunomodulation effect is also seen by this mushroom. Most abundantly it reduces stress and also use in chronic disease like hepatitis.

Edodes lentinula

Lentinan yield in this mushroom which contain a b-glucan which overcome tumour cell reproduction & isolation of mushroom using ethanol also inhibit cell regeneration activity this isolated solution may block or arrest the G1 phase so that cell proliferation activity has been inhibited [11] it mainly act on immune system or as apoptosis of the cell. Approximately 34 kcal given by this mushroom when 100gm mushroom is consume on daily basis. It use as an antioxidant & in treatment of atherosclerosis. This mushroom is effective against most of the virus like hepatitis virus, herpes virus, papillomavirus and influenza virus and so on. When this mushroom consumes orally may possess different side effect.

Generally, the side effect shown by the mushroom is more toward the skin disorder or skin problem. That is inflammation, allergic reaction on skin and makes skin more sensitive toward the sun rays. It also created some other adverse effect like respiratory disorder and also causes soreness to the stomach

The consumption of this mushroom is mostly avoided during pregnancy and breastfeeding

Coriolus versicolor

The secondary name or synonym of these mushroom is turkey tail or cloud mushroom. It shows action against different cancer. The isolation of active component of these mushroom shows action against hormone which is responsible for growth and it mainly acts on prostate cancer. This mushroom is mainly act on hormone dependent cancer [12]. This mushroom also use in treatment of lung cancer, gastric cancer, leukaemia & lymphoma. This mushroom on daily intake may cause prevention of breast cancer. The mechanism of action of this mushroom is to *apoptosis*.

Grifola frondosa

Dancing mushroom is most common name of this mushroom. Absolve of this mushroom with glucan may increase in activity of the agent which act on cancer like cisplatin. This drug shows a maximum efficacy against human gastric cancer when this mushroom is given with 5- fluorouracil. The chemical nature of this drug contain sulphur in there polysaccharide ring. These mushrooms mainly act against gastric cancer or adenocarcinoma. The main mechanism of action of this drug against cancer is that by apoptosis of cancerous cell of the

body or specifically gastric cell. The main action shown by mushroom is that it mainly control on mitochondrial cell of the given cancerous cell with activation of caspase 3. Due to apoptosis, it may prevent proliferation formation which may then converted into cancer [13].

Genus Ganodermalucidum

Reishi is the synonym of this mushroom. These mushroom is widely use in Asia from many year ago or hundred year ago .in Asia most popular name is reishi. This mushroom is mainly use in treatment of cancer. This mushroom is also called as immortality. The drug is mainly given single or combination with the radiotherapy that is it is given after radiotherapy is given to the patient & after chemotherapy has been given to the patient. The given mushroom shows more effectiveness toward gastric carcinoma when this drug or isolation of active constituent of the given mushroom by using ethanol. This drug may activate certain type of protein which act as a death cell & destructiveness of tumour cell by apoptosis. In this apoptosis, there is prevent transformation of mutation to proliferation which may cause cancer in the body and there is activation of caspase-8 and caspase-9 this caspase mainly act on mitochondria which act as energy source in cancer development or cancer growth, it also act on death receptor[14]. These drugs contain an acidic constituent which prevent an accumulation of cell and also prevent cell exodus. This cell also arrest G2/M phase[9].

Heridium erinaceus

The most popularly accepted name of this mushroom is lion mane. This mushroom may use in treatment of cancer and also enhance immunity. This may mushroom may act as angiogenesis inhibition & also mobilize macrophages so that there is decrease in amount of tumour cell in the body. This mushroom also inhibit the release of COX-2& 5-LOX.

So due to inhibition it is also use in treatment of pain & inflammation occur in the body. There is 38-40% reduction of amount of a cancerous cell in the body when it taken for 2 week daily from its actual weight. The mechanism of action of this mushroom is the apoptosis of the given cell so that which prevent the proliferation of cell. This also stops the cancerous cycle by blocking cell proliferation. [4]

Cordyceps militaris

If there is derive of active constitute in exonerate form act on tumour necrosis factor and also effect on interleukin and also cause macrophages and proliferation against cancer so that there is prevention of cancer problem it's mainly use for treatment of prostate cancer, colon, and hepatoma cell [4]. There is a dendritic cell mainly contain antigen which mainly increase the immunity of the human body against cancer cell. Nowadays dendritic therapy is mostly use for prevention of cancer. Dendritic cell mainly exhibit large proportion of CD 40 (cluster of differentiation 40), CD 80 (cluster of differentiation 80), CD 86 (cluster of differentiation 86), MHC-I (Major histocompatibility complex) & MHC-II molecule which is also an antigen which also increase the immunity of the human body. The cluster of differentiation is mainly act as antigen and enhances human body immunity. Generally, this CD is mainly act on ligand [15, 16]. generally, dendritic cell increase human body immunity which also useful for the prevention of cancerous cell or tumour. There is decrease in success of cancer treatment specifically immunity modulation because it's mainly pull out dendritic cell so that it may create problem in immunomodulation action.

In treatment of leukaemia these type of mushroom is mainly use the mechanism of action of this mushroom is that it mainly cause apoptosis and apoptosis action mainly done by due to reactive oxygen species (ROS), mitochondrial dysfunction, exhilarating of the caspase, there is also cleavage of the protein like ADP-ribose so that due to these action apoptosis of the leukemic cell may occurred.

Boletus badius

This mushroom is easily available throughout the world. These drug contain large proportion of L-theanine so that it useful for the treatment of cancer. This mushroom does not cure cancer but enhance the activity of antitumor drug like doxorubicin, cisplatin, & anthracyclines. Due to increase in activity of anticancer drug it mainly uses in cancer chemotherapy for a synergistic effect of the drug [9]. The cap of this mushroom possess variety of colour.

Calvatia utriformis

Calvatia utriformis is a fungus of species *H. utriformis* of genus *Handkea* belonging to family *Lycoperdaceae*. The most popular name of this mushroom is puffballs. This mushroom possesses anti carcinogenic activity. This mushroom mostly use in china and Taiwan as haemorrhagic bleeding, loss of voice and coughing and throat pain. This mushroom also possesses antimicrobial activity. On breast cancer, this mushroom shows by anti-proliferation that is it prevent transformation of cell into cancerous cell. This mushroom also shows.

There is extraction of protein like calcaelin which possesses ribosome inactivating activity so its shows anti-mitogenic activity. It also shows antibiotic activity. It also use in treatment of gastric ulcer and gastric cancer mainly cause by H-pylori [17].

Schizophyllum commune

It is a fungus of *Schizophyllaceae* family. The most popular name of this mushroom in china is split-gill mushroom. So this mushroom is largely consumed in china. The schizophyllan is a homopolysaccharide and it is non-ionic and water soluble in nature. Generally, this mushroom is aromatic in taste it is mainly use as anti-cancer drug and in pharmaceutical as an immunity enhancer [18]. It is use in treatment of cancer as well as it is use in different other disorder like antifungal and antiviral. Also, possess anti-oxidant activity

It also possesses the activity like to increase immunity so that many pharmaceutical company may work on that to prepare a immunomodulation product using this mushroom

Flammulina velutipes

It is fungi of genus *flammulina* belonging to family *Physalacriaceae*. This is digestible mushroom most popular name as winter mushroom. It possesses anticancer as well as antioxidant activity. Generally, acetone extract of this mushroom may act as anti-cancer against breast cancer. It also inhibitor acts as anti-proliferation activity against leukaemia. On oral administration of protein of this mushroom shows anti-tumour activity. Generally, the protein of this mushroom possesses immunomodulation activity. This mushroom contains rich proportion of protein. These mushroom may possess some adverse effect like it give cytotoxic activity to the patient when it consume in large proportion[19].

Inocybeumbrinella

Most common name of this mushroom is psilocybin. This mushroom is also well known by magic mushroom. It most abundantly use in treatment of antipsychotic rather than anticancer. It decrease anxiety also cause mood improvisation. The antipsychotic activity is mainly shown due to presence of psychoactive compound psilocybin in large proportion. So due to decrease in anxiety activity this drug is most of the time misuse by the person so that its constitutionality may vary from country to country. This mushroom are not mainly use in treatment of cancer but use in treatment of depression which mainly cause due to the possess of cancer.

There is about 40% people in world may recognise by cancer so that which depresses the mindset and also cause anxiety which tends to enhance the destructive mindset and also decrease durability of the human. So this mushroom is also use as a placebo but more effective than placebo [20].

The treatment of anti-anxiety by this drug is long term treatment approximately 5-6 month should be taken by these mushroom to cure from anxiety and after that, if there is consume mushroom on daily basis may reduce suicidal tendency and improving human life.

In future aspect, many company may prepared this anticancer drug using this drug or mushroom. Most of chines company are formulate anticancer drug using different mushroom although other country also prepared anticancer drug using mushroom as an active constituent.

Neutraceutical formulation mushroom

Neutraceutical is composing of two different words that are pharmaceutics and nutrient. The neutraceutical first discover in 1989. The food helps to stop or cure the person or animal from disease. In neutraceutical formulation there is extraction of active component from different food material and depleted in medicinal form. Neutraceutical formulation act as a barrier against all type of chronic disease. [21] America is the country which is largely use neutraceutical formulation these neutraceutical uses in various type of disease condition like for congestive heart disease, for weight loss, for cancer and for arthritis also. In Japan there is about 47% of people eat u neutraceutical formulation out of total population [22]. The neutraceutical formulations of mushroom for cancer as well as other disease are as follow.

Organic Reishi

Name of the product itself indicate that it is combination of two mushrooms that is the 50% lucidum means reishi and 50% of Lentinula that is shiitake. These mushroom is eat up from long period of time by China. The properties or uses of these mushroom is to cure from cancer disease as an antiviral, immunity enhancer and as anti-cholesterol [11, 14]. Elevation of this mushroom is under antiseptic condition. The collection of these mushrooms is done until it reaches its maximum bioactive concentration. After that it collected and make powder of that mushroom and purity of mushroom is maintain [23].

Organic trimyco-gen

it is also in dust form. These products consist of three mushrooms that are Cordyceps, lucidum and Lentinula. The concentration of this three mushrooms is 33% Cordyceps, 33% lucidum and 33% Lentinula. Farming of Cordyceps very difficult but nowadays this difficulty has been overcome. Cordyceps has higher ability to boost up human health, Cordyceps growing in summer for short period of time. A hygienic condition is maintain during agronomy of this mushroom [24].

Organic rare red reishi

This mushroom is mainly made up of one type of mushroom that is reishi means Ganodermalucidum. It is consume in china over long period of time. It contains large proportion of polysaccharide, amino acid, protein, ascorbic acid, sterol, lipid, alkaloid, volatile oil, and many more, so that due this constituent it possesses anticancer activity and immunity enhancer activity [25].

CONCLUSION

Medical mushroom is mainly naturally available and has less toxic effect or adverse effect shown by this mushroom as compare to the chemotherapy radiation therapy or other drug. So due to less toxic effect, it us most useful & many pharma company prepared the anticancer drug using mushroom as an active constituent or main ingredient in formulation. The using of mushroom in treatment of mushroom cancer is from since ancient time. There is known of active constituent present in different mushroom and there mechanism of action on cancer cell and each and every tumour component or the cell. In there the mainly how to prevent

cancer cell growth or cell death occur which mean due to the apoptosis, anti-proliferation or due to antioxidant activity there is death of cancerous cell may occur. There is finding that most of the mushroom are use in treatment of cancer like breast cancer, leukaemia, acute myeloid, & Hodgkin disease. Some mushroom also use in treatment of anxiety or act as an antipsychotic. These mushroom also use in combination with chemotherapy to enhance the activity of chemotherapy drugs.

REFERENCES

1. Hobbs C, an analysis of heritage, curing, and ability. Medicinal mushroom (1995) 251.
2. Jiang J, Silva D cut off expansion and spread of human breast cancer cells curative mushroom. Int Oncology 37: (2010) 1529–1536.
3. Barros L, Baptista P, Estevinho LM, Ferreira ICFR Bioactiveproperties of the medicinal mushroom *Leucopaxillus giganteus* mycelium obtained in the presence of different nitrogen sources. Food Chem 105: (2007) 179–186.
4. Baker JR, Kim J-S, Park S-Y (2008) Constituent and prospective arrangement of a water-soluble glycan *Phellinus linteus*. Fitoterapia 79:345–350.
5. Lu T-L, Huang G-J, Lu T-J, Wu J-B, Wu C-H, Yang T-C, Iizuka A, Chen Y-F (2009) Hispolon from *Phellinus linteus* has ant proliferative effects breast and bladder cancer.
6. Kalotas A. ("Aboriginal knowledge and use of fungi". Introduction—*Fungi in the Environment. Fungi of Australia. 1B. Melbourne: CSIRO. pp. (996) 269–95. ISBN 978-0-643-05936-8.*
7. Lu T-L, Huang G-J, Lu T-J, Wu J-B, Wu C-H, Yang T-C, Iizuka A, Chen Y-F (ant proliferative effect of *Phellinus* by means of Hispolon on breast and bladder cancer cells. Food Chem Toxically 47:((2009) 2013–2021.
8. Lavi I, Friesem D, Geresh S, Hadar Y, Schwartz B An aqueous polysaccharide extract from the edible mushroom *Pleurotus ostreatus* induces anti-proliferative and pro-apoptotic effects on HT-29 colon cancer cells. Cancer Lett 244: (2006)61–70.
9. Li YR, Liu QH, Wang HX, Ng TB (A novel lectin with potent antitumor, mutagenic and HIV-1 reverse transcriptase inhibitory activities from the edible mushroom *Pleurotus citrinopileatus*. Biochim Biopsy's Acta 1780(2008):51–57.
10. Chang H-H, Chien P-J, Tong M-H, Sheu F Mushroom immune enhancer proteins(2007).
11. GU Y-H, Belury MA Selective induction of apoptosis in murine skin carcinoma cells(2005).
12. Hsieh TC, Wu JM Cell expansion and gene regulatory activities on prostate cancer cells. Int J Oncol 18: (2001) 81–88.
13. Cui F-J, Li Y, Xu Y-Y, Liu Z-Q, Huang D-M, Zhang Z-C, Tao W-Ydraft of self-destruction in cells by *Grifola frondosa*GF9801. Toxicol In Vitro 21: (2007) 417–427.
14. Jang K-J, Han M-H, Lee B-H, Kim B-W, Kim C-H, Yoon H-M, Choi Y-H Self-destruction of human gastric cell cause by ethanol isolation of *Ganoderma lucidum*. J Acu-punct Meridian Stud 3: (2010) 24–31.
15. Rao Y-K, Fang S-H, Wu W-S, Tzeng Y-M extraction of active component of *Cordyceps* decrease inflammatory pacemaker cancer cell proliferation Ethnopharmacol 131: (2010) 363–367.
16. Zhang Y, Cao HJ, Graf B, et al. CD40 assurance to stimulus cyclooxygenase-2 phrase and prostaglandin E2 formulation in human lung. J Immunol 1998;160:1053–7.
17. Lam YW, Ng TB, Wang HX) puffed mushroom shows effect of anti proliferative and anti mitogenic Biochem Biophys Res Commun 289: (2001)744–749.
18. Coetzee JC, van Wyk AE The genus *Calvatia*(2009).
19. Kumari M, Survase SA, Singhal RS (Production of schizophyllan. Bioresour Technol 99:(2008) 1036–1043.
20. Grob CS, Danforth AL, Chopra GS, Hagerty M, McKay CR, Halberstadt AL, Greer GR Pilot study of psilocybin treatment for anxiety in patients with advanced-stage cancer. Arch Gen Psychiatry 68: (2011) 71–78.

21. Rajasekaran A, Sivagnanam G, Xavier R. Neutraceutical as therapeutic agents: A Review. *Research J. Pharm. and Tech.* 1(4); 2008: 328-340.
22. Stephen D. A report of Neutraceutical India webinar; 2012: 1-22.
23. Chang ST, Buswell JA Medicinal mushrooms—a prominent source of neutraceutical for the 21st century. *Curr Trends NeutraceuticalRes* (2003) 1:257–280.
24. Law, David. Fungi as a platform for new medicine. *Mushroom World*, December 1996.s
25. Wiley, CSS. Medicinal side of mushrooms. *Vegetarian Times*, March 1991.

