

A Short Review on Beta-Glucan, a Substance for Alternative Therapy for Cancerous Patient

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Abstract

Introduction: At present, complementary and alternative medicine has brought hope for many hopeless patients. Most cancerous patients who also use alternative medicine prefer this combination of alternative and conventional medicine since they are of the opinion that this combination is superior to either alone, which can be referred to as raising new hopes.

Methods: A literature review on this topic was performed.

Results: In this paper, the author briefly discusses an important nutraceutical, beta-glucan.

Conclusion: There are many interesting reports confirming its usefulness as a cancer killer in animal models. Some interesting reports are hereby listed in the short article.

Keywords: beta glucan, cancer, therapy

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Introduction

At present, complementary and alternative medicine has brought hope for many hopeless patients. The alternative medicine can be the actual alternative for the health management of those patients [1 - 4]. The methods of alternative medicine can be any medical and health care system, practice, or product that is not presently considered to be part of conventional medicine [1 - 4]. It also includes any method that is out of the concept of western classical biomedical model of disease, diagnosis, and treatment [1-4]. The examples of alternative medicine include mind-body interventions, manipulative and body-based methods, energy therapy, herbs and nutraceuticals [1-4].

Among hopeless patients, cancerous patients are an important group. Basically, cancer is an abnormal growth of cells and tissues of humans that can lead to death. This disease is considered untreatable. The present treatment regimen is still not fully effective, poses many complications and still needs further development.

Most cancerous patients who also use alternative medicine prefer this combination of alternative and conventional medicine since they are of the opinion that this combination is superior to either alone, which can be referred to as raising new hopes [5]. In this paper, the author briefly discusses an important nutraceutical, beta-glucan, that is a food or part of a

food and provides medical or health benefits including prevention and treatment of cancer.

The interplay of nutraceuticals with the immune system

The interplay of nutraceuticals with the immune system is an interesting topic at present since it is not very well focused in scientific debates and communications. Indeed, the concept started years ago. Alexander and Peck [6] proposed the effects of dietary therapy or pharmacologic nutrition in many cases including patients after burn injuries or those with vascular diseases, and in animals for the prevention of gut origin sepsis, prevention and treatment of infection, prevention and treatment of secondary lesions in autoimmune diseases, augmentation of immunosuppression in transplantation, and in the treatment of cancer. Garlick and McNurlan [7] stated that "when the composition of the amino acids given to the patient was changed from a balanced mixture to one supplemented with branched chain amino acids, the response of the tumor to feeding was significantly diminished, suggesting that tumour growth might be modulated by diet composition".

The interplay of nutraceuticals with the immune system is accepted as the immunomodulation. Briefly, after ingestion, an interaction between diet and the metabolic events is expected [8]. These events start from the modulation of the immune function of the gut

mucosa and further acts on the immune system after absorption into the blood stream [8]. The stimulation of either cellular or humeral immune system by nutraceuticals can be seen [9]. The immunomodulating phenomenon within human body due to nutraceuticals also covers the disruption of the proinflammatory cascade through a variety of mechanisms, including antioxidant effects, alterations in cell signaling (the nuclear factor (NF)-kappa B pathway in particular), cytokines, proinflammatory mediators, and alteration of bacterial flora [9].

Basic knowledge on beta-glucan [10-12]

Beta -glucan is a specific fiber-type complex polysaccharide which can be derived from the cell wall of baker's yeast, oat and barley, and many medicinal mushrooms such as Maitake and Lin Zhi. In details, yeast and mushrooms contain a mixture of beta -1,3-glucan and beta -1,6-glucan while oats and barley contain a mixture of beta -1,3-glucan and beta -1,4-glucan. However, similar (although not identical) properties can be derived for β - glucan-rich extracts and purified β - glucan derived from oats, baker's yeast, and mushrooms.

Basically, beta-glucan is clarified for its property to enhance immune system and to lower blood lipid components. In addition, beta -glucan, especially for the 1, 3 form, shows strong efficacy for activating white blood cells known as macrophages and neutrophils. This is the underlying mechanism for tumor apoptosis.

Beta-glucan-activated macrophages or neutrophils can recognize and kill abnormal cells including abnormal cancerous cells [13, 14]. This is called an immune modifier. This concept can be seen in other new accepted antitumor drugs such as Emiquimod.

At present, as a nutraceutical, beta-glucan widely is available in the liquid form as well as in capsules and tablets. It is accepted as a food supplements not a medication. However, beta-glucan, in spite of being a polysaccharide, cannot give excessive energy to the body since it is not digestible in the human gastrointestinal tract. Therefore, the intact molecule is absorbed and plays its useful role in cardiovascular and immune systems [13, 14]. However, the main concern for using beta-glucan in clinical practice is that there is no standard recommended dosage.

Information on immunological effects with emphasis on anti-cancer effects of β -glucan

Immunological effects of beta-glucan are confirmed [15]. It is proved that Beta-glucan stimulates phagocytic activity as well as synthesis and

release of interleukin-1(IL-1), IL-2, IL-4, IL-6, IL-8, IL-13, and tumor necrosis factor-alpha [15]. The stimulation of phagocytosis is the main process that produces a cellular destructive function to foreign bodies including pathogens and abnormal cells [16]. Akramiene et al [17] reported that beta-glucan has a specific interaction with several cell surface receptors such as Complement Receptor 3 (CR3; CD11b/CD18), lactosylceramide, selected scavenger receptors, and dectin-1. Harada and Ohno [18] investigated the response of leukocytes to beta-glucan and reported that production of Granulocyte Macrophage-Colony Stimulating Factor (GM-CSF) and expression of dectin-1, a receptor located on macrophages, play a key biological role in this activity. Then, dentin-1 expression further mediates beta-glucan activation of phagocytosis and production of cytokines, a response co-ordinated by the toll-like receptor-2 [19]. In addition, at least two other receptors, scavenger and lactosylceramide, bind to beta-glucan and mediate a series of signal pathways leading to immunological activation [19].

In addition, beta-glucan is reported to have inhibitory effects on the growth of tumor cells in vivo and affects expression of several important genes in cancer cells [15]. Cell-cycle arrest and induction of apoptosis can be seen [20]. Activated complement receptors on natural killer cells, neutrophils, and lymphocytes may also be associated with the detected tumor cytotoxicity [19]. An adjuvant effect can also be observed on antibody production [21, 22].

Evidences on usefulness of beta-glucan in cancer treatment

Although there is no definitive evidence that beta-glucan can be successfully used as anti-cancer agents in human beings, there are many interesting reports confirming its usefulness as a cancer killer in animal models. Few reports are available in human beings [21, 25]. Some interesting reports are hereby listed in Table 1. At this stage, it can be said that there is some "on trial" evidence that beta-glucan is useful in cancer treatment in terms of adjuvant or supplementation therapy but not as a standard replacement therapy. Administration of the standard cancer treatment protocol is still recommended.

Safety and side effect(s) of beta-glucan as a supplemented nutraceutical for cancerous patients

As a fact in medicine, the comment on the safety and side effect(s) of any classical or alternative medical practice should be addressed. For beta-glucan as a supplemented nutraceutical for

Table 1. Reports showing usefulness of beta-glucan in cancer therapy

Authors	Details
Weitberg [23]	Weitberg reported on a phase I/II trial of beta-1,3/1,6 beta-glucan in the treatment of patients with advanced malignancies receiving chemotherapy. Weitberg said that beta-glucan could be well-tolerated in cancer patients receiving chemotherapy and this implied that beta – glucan might have a beneficial effect on hematopoiesis via immune stimulation.
Driscoll et al [24]	Driscoll et al reported on the therapeutic potential of various beta-glucan sources in conjunction with anti-tumor monoclonal antibody in cancer therapy.
Yamamoto et al [25]	Yamamoto et al reported on anti-angiogenic and anti-metastatic effects of beta-1, 3-beta-glucan purified from <i>Hanabiratake</i> , <i>Sparassis crispa</i> . Yamamoto et al mentioned that the oral administration of beta glucan could result in a suppressive effect on tumor growth and metastasis in lung through the inhibition of tumor induced-angiogenesis.
Yoon et al [21]	Yoon et al reported on anti-tumor metastatic activity of beta-glucan purified from mutated <i>Saccharomyces cerevisiae</i> and said that the effect was due to neutrophil and macrophage stimulation.
Shim et al [22]	Shim et al reported on the antitumor effects of soluble beta-1, 3-glucan from <i>Agrobacterium</i> sp. R259 KCTC 1019 and concluded that the identified effect was owing to neutrophil and macrophage stimulation.

cancerous patients, there is no report on its side effects. This might imply the safety of its administration. However, based on the experience of the author, an important comment from the user of this nutraceutical is the change of stool appearance in the first week of usage. This can be explained by the fact that beta-glucan is a kind of large polysaccharide and might act as a laxative that helps with defecation. Similar to some antilipid drugs, beta-glucan can absorb fat and other substances within the intestine to form feces.

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Conflict of interests

The authors have no conflict of interests in this article.

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