Compounding with 
\(\beta\)-1,3-D-Glucan

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\(\beta\)-1,3-D-glucan, a homopolymer of glucose, is a brown powder consisting of \(\beta\)-1,3-linked glucopyranose polymers, which are insoluble molecules in all solvents. It is a derivative of the polysaccharide \(\beta\)-glucan, which was first used to prevent infections in hatchery-raised fish. \(\beta\)-1,3-D-glucan is found in the cell walls of bakers’ yeast and other fungi. Maitake and shiitake mushrooms, for example, contain many d-fraction glucans, the most potent of which is \(\beta\)-1,3-D-glucan.\(^1\) The extracts of those mushrooms are approved in Japan for the treatment of certain cancers, such as those of the breast, prostate, brain, and liver. Adverse drug interactions are not associated with \(\beta\)-1,3-D-glucan, and it is nontoxic. Its use is not contraindicated in conjunction with any treatments, including chemotherapy or radiation therapy. In this article, various therapeutic applications of \(\beta\)-1,3-D-glucan and its effect on the role of the macrophage in immune system functioning are presented.

\(\beta\)-1,3-D-Glucan and Immune System Function

The complex network of cells, tissues, soluble factors, and functions known as the immune system is the body’s protection from damage caused by destructive agents such as bacteria, viruses, fungi, parasites, radiation exposure, cancer, and environmental toxins. The good health of any organism depends on a properly functioning immune system, which mounts a 2-stage response to an antigenic agent. First, a nonspecific inflammatory response isolates an offending biologic agent and then destroys, neutralizes, or otherwise renders it harmless, which prevents cellular damage. In this initial response, white blood cells known as macrophages (“big eaters”) are of paramount importance. The macrophage identifies and engulfs injurious agents to render them harmless and then displays portions of the engulphed agent on its surface so that another type of white blood cell (the helper T cell) can attach itself to the macrophage. It is this union of the helper T cell and the macrophage that starts the cascade of events enabling an effective immune system response to the injurious agent. The initial response also involves the production of interleukin-1 and interleukin-2, tumor necrosis factor, and interferon. The interleukins activate B cells and killer T cells. The proliferation of infection is inhibited by activated B cells, which produce antibodies specific to the injurious agent, and by the action of killer T cells, which produce powerful chemicals that destroy tumor cells, damaged cells, and those infected by the invading agent. The antibodies produced by B cells attach to invading agents, which are then engulfed and destroyed by the macrophages. As the infection subsides, activated B cells are inactivated by suppressor T cells. The immune system retains a memory of the agent against which a defense has been waged; this enables a much faster response to a subsequent encounter with that specific antigen.

A compromised immune system can result in the development of autoimmune disorders such as rheumatoid arthritis or lupus and in a predisposition to certain cancers or to hypersensitivities such as allergies or colitis. Any chemical entity that enhances the activity of the macrophage also benefits immune system function.

Various organs of the body have specialized macrophage cells that are unique: the alveolar macrophage in the lungs, the Kupffer cell (liver), the Langerhans cell (skin), the mesangial cell (kidney), the synovial type A cell (joints), the microglial cell (brain), the monocyte (blood), the serosal cell (endothelial layer), and the interdigitating cell and the neutrophil (various tissues).

\(\beta\)-1,3-D-glucan enhances the ability of the macrophage to identify “foreign” cells. Studies\(^2\) have shown that the administration of \(\beta\)-1,3-D-glucan profoundly increases the proliferation of macrophages and increases phagocytic activity and secretory activity in humans and in animal models, which respond similarly. The macrophages of subjects who had received \(\beta\)-1,3-D-glucan exhibited better chemotactic activity and cytolytic action toward tumor cells, as well as better interaction with complement, than did those of untreated subjects. Such responses enhance immune system function.\(^3\)

\(\beta\)-1,3-D-Glucan in Pharmacy Practice

\(\beta\)-1,3-D-glucan can be administered orally or topically. Orally administered \(\beta\)-1,3-D-glucan should be taken on an empty stomach, after which no food or water should be ingested for 30 minutes. \(\beta\)-1,3-D-glucan passes first into the lymphatic system and then into the bloodstream. This polysaccharide is much more effective when taken in combination with an antioxidant formula nutrient that includes at least 2000 mg of vitamin C. Listed below are various applications for \(\beta\)-1,3-D-glucan.

Infectious Diseases

I have been using \(\beta\)-1,3-D-glucan in my pharmacy for more than 3 years to treat chronic illnesses in both humans and in animals. It is considered safe and effective by most researchers.\(^4\) Patients with a chronic infection take it alone or in combination with antibiotics with a considerable amount of success. I use it prophylactically (sometimes in combination with itraconazole) to prevent an acute sinus infection.

\(\beta\)-1,3-D-glucan benefits patients with herpesvirus type 1 or type 2 infection and prevents subsequent reinfection. Those with pep-
tic ulcers respond very well when treated with the usual antimicrobial cocktail of tetracycline, bismuth salts, and metronidazole and 500 mg of β-1,3-D-glucan taken daily. Some physicians routinely prescribe it for those with chronic sinusitis, prostatitis, chronic fatigue syndrome, chronic otitis media, tonsillitis, human papillomavirus infection, chronic or refractory bronchitis, cytomegalovirus infection, periodontal disease, hepatitis C infection, mononucleosis, or influenza. It is also prescribed by veterinarians to treat similar chronic infections.

Patients with chronic sinusitis are advised to take β-1,3-D-glucan at a dose of 25 mg/kg per day for 7 days; then 12.5 mg/kg per day for 7 days, and finally 6.25 mg/kg until the infection has resolved. A maintenance dose of 6.25 mg/kg per day is given for several weeks to prevent reinfection. The same dose applies in the treatment of all chronic infections and is especially applicable as a maintenance dose in the treatment of chronic prostatitis.

Allergy and Breathing Disorders

Allergy sufferers take the above-mentioned doses, including an oral maintenance dose of 500 mg/day in addition to 6000 mg/day of methyl sulfonyl methane (MSM) both during the allergy season and 30 to 60 days before the season begins. I also use β-1,3-D-glucan to compound nasal sprays and gels for patients with allergies.

Patients with emphysema are treated with 1 g/day of β-1,3-D-glucan until lung function improves, after which a maintenance dose of 500 mg/day is recommended. Lung function improves in those patients, and they breathe more easily. Great increases in lung function over a period of several months of such treatment have been reported by patients who have used the product.

Neoplastic Disease and the Side Effects of Treatment

Patients with certain cancers also respond positively to treatment with β-1,3-D-glucan. To avoid the serious side effects produced by tamoxifen, some breast cancer patients have opted to take prophylactic β-1,3-D-glucan to prevent recurrence. Such patients have also used it as an adjunct to chemotherapy to maintain white blood cell counts at a proper level. Any cancer patient who will allow me to suggest alternative procedures is advised to take between 1500 and 3000 mg of β-1,3-D-glucan daily. This palliates the damage to immune system cells caused by chemotherapy or radiation, and I believe that it assists immune system defense against tumor cells. It has protected patients from the side effects of radiation therapy, such as skin burning and pneumonia, when administered in a daily 3-g dose that is initiated at least 3 days before the patient’s treatment and is continued 3 days after treatment. A maintenance dosage of 1 g/day is then used indefinitely to ensure that the tumor does not recur.

Research from the Experimental Hematology Department of the Armed Forces Radiobiology Research Institute in Bethesda, Maryland, has indicated that orally administered β-1,3-D-glucan is radioprotective. It protects macrophages from free-radical damage and enables them to scavenge the cellular breakdown of skin cells and other debris caused by radiation. After β-1,3-D-glucan is administered orally to the patient, macrophages release a hematopoietic factor that restores the bone marrow production necessary for survival after a radioactive assault. In the study cited, 25 mice were treated with oral β-1,3-D-glucan (50 mg/kg) and 25 mice were untreated until the experiment was concluded. Three days after treatment with β-1,3-D-glucan was initiated, both groups of mice received the minimum lethal dose of radiation. All control mice died, and all mice pretreated with treated β-1,3-D-glucan survived the radioactive assault for several weeks. Seventy percent of the surviving mice had been completely protected.

Diabetes

In patients with type 2 diabetes, oral β-1,3-D-glucan (500 mg/day) helps to lower blood sugar and also enhances the activity of the insulin-resistant macrophage, which functions abnormally as a result of exposure to high levels of insulin. For several hours after insul-
resistant patients have eaten a high-glycemic meal, their macrophage response to challenge is less than normal. Oral administration of β-1,3-D-glucan in the dosage cited above seems to prevent this from occurring and may enable the insulin-resistant cells to function normally. I recommend oral β-1,3-D-glucan (500 mg/day) to all patients in whom I suspect insulin resistance (or related symptoms such as hyperlipidemia or hypertension), and those patients improve.

**Hypertension, Cholesterol, and Liver Disease**

β-1,3-D-glucan lowers blood pressure in hypertensive patients and is also useful in lowering LDL cholesterol. Reversal of cirrhosis of the liver is noted in patients treated with the oral administration of β-1,3-D-glucan (1500 mg/day).

**Autoimmune Disorders**

Because the administration of β-1,3-D-glucan refines and improves the macrophage function of identifying extraneous injurious agents, it does not exacerbate a malfunctioning immune system in patients with an autoimmune disorder, and it safely palliates the effects of certain autoimmune diseases. Patients with lupus or interstitial cystitis respond well to treatment with a combination of β-1,3-D-glucan and MSM, which alleviates some or most of the symptoms of disease.

**Dermatologic Applications**

Recent research indicates that β-1,3-D-glucan affects the Langerhans cell, which enables wound healing and protects the skin from infection, tumors, and damage from the sun. I combine β-1,3-D-glucan with silver sulfadiazine products for the oral or topical treatment of burns. I also add it to commercially manufactured products that treat acne to enhance their efficacy and have found it an effective acne treatment when combined with retinoic acid, niacinamide, and α-lipoic acid. β-1,3-D-glucan prevents scarring, reverses sun damage, and provides protection from ultraviolet A and B radiation and resultant skin tumors. It is also effective in the treatment of melanoma, and I have used both oral and topical doses in combination with 2-deoxy-D-glucose and 5-fluorouracil (5-FU) for the treatment of human papillomavirus, herpes simplex, and plantar warts. A topically applied dose of as little as 20 mg/mL greatly improves the healing time of skin wounds and pressure ulcers, which I have also treated successfully with a combination of misoprostol, phenytoin, and β-1,3-D-glucan. That combination works better and faster than any other product that I have compounded. β-1,3-D-glucan also acts as a long-term natural sunscreen and does not produce the side effects associated with the use of strong chemical sunscreens. I believe that adding it to traditional sunscreens would produce a product far superior to ordinary sunscreens.

The beneficial dermatologic effects of topical β-1,3-D-glucan have led to its more frequent use in cosmetic and cosmeceutical products. I use it in all my compounded cosmetic products, such as moisturizers, cleansers, acne products, toners, eye gels and creams, and antiaging lotions. It increases skin hydration by 27%, reduces lines and wrinkles that are the result of sun damage by more than 47%, increases skin elasticity by 60%, and increases skin renewal by 30%. It produces results far superior to those of any retinoic acid product. β-1,3-D-glucan is also an excellent pretreatment for those who are to undergo a cosmetic procedure such as chemical or laser facial resur-
facing. Skin infections are nonexistent in pretreated patients, who heal faster and with less erythema than patients who have not been pretreated.

Additional Benefits of Treatment

The benefits provided by treatment with β-1,3-D-glucan extend across the spectrum of medical care. In addition to the applications described previously, I have successfully used it in the following therapies:

- In vaginal creams, gels, and suppositories for the treatment of chronic vaginitis
- In oral doses for the treatment of periodontal disease and as a pretreatment for patients who will undergo dental surgery
- In mouthwash for the treatment of aphthous ulcers
- As an oral medication (1 g/day) in the treatment of chronic fatigue (90% of my patients with that syndrome benefited from that ongoing protocol)
- In combination with ribavirin, milk thistle, niacinamide, and various other nutrients to prevent liver cancer and the problems associated with hepatitis C
- In the oral or topical treatment of otitis media in humans and animals, especially when the results of cultures indicate an infection with Pseudomonas aeruginosa, Proteus vulgaris, or Proteus morganii
- In combination with an antibiotic for the treatment of urinary tract infections; patients in nursing homes who have infections such as P. aeruginosa, P. vulgaris, or P. morganii respond well to that combination therapy
- In combination with penicillin for the treatment of chronic tonsillitis
- In the treatment of patients with peritonitis, colds, or flu infections, because it is a potent antiviral
- In the treatment of patients with Staphylococcus aureus sepsis

I do not know of a single negative effect that resulted from treatment with β-1,3-D-glucan. Even patients with an autoimmune disease do not have negative effects as a result of such treatment.

Case Reports

The following case studies are representative of the multiple effective applications of β-1,3-D-glucan.

Case 1

A 22-year-old woman with a severe burn on her inner thigh caused by a motorcycle muffler was given both topical (30 mg/mL in an emollient cream base) and oral preparations (1500 mg for 7 days and then 1000 mg for 7 days, followed by a maintenance dosage of 500 mg/day) of β-1,3-D-glucan within minutes of having sustained the burn. Twenty days after injury, the burn had healed, and no residual tissue damage (scarring or noticeable skin damage) remained.

Case 2

A 41-year-old woman with chronic seasonal allergies was taking 2 antihistamines to control symptoms. She was placed on a daily regimen of β-1,3-D-glucan (500 mg daily) and MSM (2000 mg 3 times per day) in addition to Benadryl and Claritin. Within 30 days of treatment initiation with combination therapy, antihistamine therapy was terminated, and the patient experienced no recurrence of symptoms until she stopped using that combination protocol.

Case 3

A 63-year-old woman with lymphoma had undergone more than 2 months of radiation therapy with a poor outcome: The therapy had had no effect on the tumor, and no other treatment options remained. After the patient had undergone 30 days of therapy with β-1,3-D-glucan (1500 mg/day for 30 days followed by a maintenance dosage of 1000 mg/day), the tumor had decreased in size. Her physician informed her that the positive response was a result of radiation therapy.

Case 4

An 18-year-old man with chronic acne was treated with a lotion consisting of β-1,3-D-glucan (30 mg/mL), niacinamide (4%), aloe vera, and α-lipoic acid (1%) that was applied daily, in addition to which he underwent salicylic acid peels. The acne subsided, and 90% of the patient’s acne scars were cleared from his face.

Conclusion

β-1,3-D-glucan is a powerful adjunct to the treatment of several disorders and should be included in every compounding practice. The only disadvantage to its use is that if treatment fails, the expense of therapy has been wasted. Those therapeutic failures, however, are most infrequent. Every compounding practice should include β-1,3-D-glucan in its armamentarium, and future studies will undoubtedly reveal new applications for this remarkable substance.

References


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