Advanced Engineering Days

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The effect of beneficial bacteria on the immunity and cancer treatment

Simay Ayden*[1], Furkan Ayaz[1, 2]

[1]*Mersin University, Biotechnology Department, Türkiye, 21140940006@mersin.edu.tr*
[2]*Mersin University, Biotechnology Research and Application Center, Türkiye, furkanayaz@mersin.edu.tr*

Cite this study: Ayden, S. Ayaz, F. (2022). The effect of beneficial bacteria on the immunity and cancer treatment.3rd Advanced Engineering Days, 23-25

Keywords
Cancer
Bacteria
Treatment
Immunity

Abstract

Today, many cancer treatment methods are being developed. Most of these methods are aimed at treating the cancerous cells directly. Rather than direct approach, regulating the immunity and metabolism to eliminate the tumor generation and growth can be another way of curing the disease. There are many types of bacteria that are in our lives and live with us to be used in the treatment of people who are at risk of cancer. These bacteria alter the state of the immunity against the tumor cells and their utilization is expected in the near future as an indirect cancer immunotherapy method. Some examples of bacteria that can be used for this purpose can be listed as: *Mycobacterium vaccae*, which is a stress-relieving bacterium, immune-boosting *Bacillus subtilis* and *Bacillus licheni formis.* In some cases, green algae such as Spirulina can also be utilized for this purpose. These methods are also known to eliminate or reduce the detrimental side effects of chemotherapy application to the cancer patients.

Introduction

Cancer cells have a special ability to evade the immune system. Therefore, it is quite difficult to design cancer vaccines [1]. Cancer comes in many different shapes. For example, breast cancer can be different from lung cancer, even two breast cancer patients' progress and disease development can be different from each other. In short, everyone's cancer is unique. Therefore, it is necessary to produce personalized vaccines for each patient [2, 3]. This is a difficult and expensive method. There are studies suggesting the involvement of bacteria to boost the immunity against tumor cells. Beneficial bacteria can be utilized for this purpose. This would enable a treatment method that would be more generalized rather than personalized vaccines to overcome the economical and production burden of the personalized medicine [4].

Results

One of these bacteria is *Mycobacterium vaccae*, has been observed to reduce stress and anxiety. This bacterium was discovered by immunologist John Stanford on the shores of Lake Kyoga in Uganda in the 1970s. Later, University of Colorado Boulder neuroscientist Dr. Chris Lowry showed that this bacterium can reduce stress and anxiety, at least in mice. It does this because it is a bacterium that increases the effectiveness of the tph2 gene, which causes the production of serotonin, an emotion-stabilizing neurotransmitter. With this feature, it can have a positive effect on the immune system by reducing stress and anxiety in people. According to the results of a Phase II trial with oral doses of *M. vaccae*, the patients who are going through TB chemotherapy had improved immunity and the oral administration of this bacteria had immunotherapy effect by shortening the chemotherapy duration and reducing the dosage of the drug [5]. Mycobacteria based immunotherapy has been effective against bladder, prostate, lung and skin cancer patients [6].

The second of these bacteria is *Bacillus subtilis* that can be found in the soil. *B. subtilis* was first described by Ferdinand Cohn in 1872. Animal tests with this bacterium reveal that this bacterium boosts their immune systems, increases antibodies in their bloodstream and increases their ability to fight infections such as Salmonella. This bacterium is already used therapeutically in humans because it produces bacitracin, an antibiotic used as an ointment for skin and eye infections. It is a very resistant microorganism. Its tough endospores have been discovered to survive for six years in space. Studies have shown that co-administration of the vaccine with *B. subtilis* spores had immunomodulatory effect by balancing the Th1 and Th2 response in mice going through papillomavirus type 16 (HPV-16) infection. When these spores are injected IV into mice, they induced the production of IFN-γ cytokines that are effective both against intracellular infections as well as tumor cells. In line with these observations when this bacteria's cellular components are used against colon cancer, hepatocellular cancer, cervical carcinoma, and human leukemia cells; they blocked the cell proliferation *in vitro* [7]. Cyclic lipopeptide (CLP) of *Bacillus subtilis* induced cell death in human leukemia cell line and more studies are required to decipher its effect on the animal models as well as patients [8].

There are signs that the third of these bacteria, *Bacillus licheniformis*, found in the soil, may help us keep our weight in check. This bacterium is also thought to be able to create this effect because some strains of the bacterium produce a substance called polygamma glutamic acid. This biopolymer also has the ability to activate large granular lymphocytes called "natural killer cells" of the immune system, and its use for cancer treatment is still being investigated [9]. Microbial L-asparaginase (ASNase) from this bacterial species blocked the cell proliferation in hepatocyte, breast and colon cancer cell lines [10].

Another species is an algae. Spirulina (Artospira) is a type of seaweed that can grow both in fresh and salt water. It is from the family of single-celled microorganisms (cyanobacteria) called blue-green algae. Studies so far indicate that it is protective against cancer. Studies show that Spirulina is somewhat effective, especially against cancerous lesions that are formed in the mouth called OSMF (Oral Submucous Fibrosis). Animal studies showed that it can inhibit cancer formation and reduce the tumor size. Spirulina is a low-fat and calorie-free, and cholesterol-free protein source containing all essential amino acids. It provides important contributions in the fight against diseases such as diabetes and anemia and in preventing the debilitating effects of the air pollution on the body. Since it contains antioxidant elements, it also has an immunizing effect against oxygen-based radicals, which are thought to be a fundamental factor in health problems such as cancer, arthritis and cataracts as well as aging. Moreover, the gamma-linolenic acid found in Spirulina leads to the dissolution of fatty deposits, helps preventing the heart ailments and lowers the bad cholesterol. The National Cancer Institute of the USA states that the sulfolipids in spirulina also reduce kidney toxicity and reduce the severity of the radiation-induced diseases. One tablespoon (7 grams) of dried spirulina powder has some amount of fat, including Vitamin B1 (thiamine), Vitamin B2 (riboflavin), Vitamin B3 (niacin), copper, iron, carbohydrates, omega-6, omega-3 and omega-9 fatty acids, 4.02 g protein, 8 mg of calcium, 14 mg of magnesium, 8 mg of phosphorus, 95 mg of potassium, 73 mg of sodium, 0.7 mg of vitamin C. It encapsulates almost every nutrient that our body needs, such as small amounts of B6 (pyridoxine), B9 (folic acid), vitamins D, A and E, chromium, selenium, and zinc [11, 12].

Discussion

In summary, there are studies on the positive effects of these four different species on the immunity that eventually leads to the eradication of the tumor cells. Based on these studies, it can be used both for the treatment purposes in cancer cases and to strengthen our immune system and prevent the development of other diseases [1].

Since Spirulina contains many vitamins, minerals and 20 different kinds of amino acids, it can be used in patients undergoing chemotherapy treatment, which can reduce the weakening of the immune system. Chemotherapy applications lead to the immunodeficiency in the patients and Spirulina might overcome this problem due to its nutritious content for the immune system cells.

More studies and clinical trials should be conducted to fully comprehend the effect of microbial or algal species on the immune system through which the treatment of cancer or other immunodeficiencies can be achieved [1, 3].

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