

## Nutrition and its Important Role in Maintaining an Adequate Immunity during Chemotherapy

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### Abstract

There is a high rate of cancer, particularly gynecological and breast cancers among American women. Chemotherapy is commonly used as a means of treating this disease, but it can cause a range of undesirable side effects. Studies have therefore been undertaken in an attempt to identify complementary forms of treatment which may reduce these side effects, and a number of compounds have produced promising results. Examples of these are the fatty acids omega-3,  $\beta$ -glucan, and glutamine, all of which have been shown to increase immunity to gynaecological cancer, and have brought about improvements in the general clinical state of patients undergoing oncological therapy. However, studies also need to be carried out to increase our understanding of the beneficial properties of particular types of nutritional substances, and of developing diagnostic methods which can detect alterations in the transport of amino-acids to cancerous cells, especially in relation to the metabolic function of glutamine, thus making it easier for medical practitioners to take decisions concerning relevant supplementary nutrition.

**Keywords:** Cancer; Chemotherapy; Metabolic function; Omega-3;  $\beta$ -glucan; Glutamine

### Role of Nutrition in Cancer Chemotherapy

Each year, almost 90,000 American women are diagnosed with gynaecological tumours and submitted to oncological treatment, such as Chemotherapy (CT) [1]. This is a very aggressive way of combatting cancer, and can produce a wide range of side effects [2]. Studies have therefore been undertaken in an attempt to identify nutritional substances which can help reduce these side effects and complement the treatment of cancer [3,4]. In this brief review, we will refer to three classes of functional and nutraceutical substances which display high potential as supplementary forms of treatment of patients undergoing CT [5].

Eicosapentaenoic Acid (EPA) and Docosahexaenoic Acid (DHA) are derivatives of the polyunsaturated acid omega-3, and have been shown to produce marked therapeutic improvements in a number of patients undergoing CT. These improvements include an increase in the effectiveness, and a reduction in the toxicity, of drugs prescribed [6,7], thereby producing a better response to CT. At the same time, there has been a considerable decrease in the side effects caused by such treatment, particularly in terms of improvement in appetite and body weight, survival rates and general quality of life, as well as a reduction in the time spent in hospital, and in the gravity of post-surgical infections [6,8,9].

It is extremely important to strengthen the immunological system during oncological treatment [10], since both the CT and the cancer itself can have a direct effect on it [1].  $\beta$ -glucan is a polysaccharide complex found in foodstuffs such as mushrooms [11] and oats [12], and is able to modulate immunity, thus maximising interactive potential, both by stimulating the survival of probiotic cultures, and

through antitumoral activity [13-17]. In addition, probiotics constitute a group of functional substances closely related to the reduction of the side effects of CT, such as diarrhoea, while contributing to improvements in the immune system by helping to modulate the micro-biotics of the intestines [18-21].

Although glutamine is not an essential amino-acid, it contributes significantly to the survival of cells, and one of its functions is to participate in the synthesis of proteins and the biosynthesis of nucleotides, while at the same time signalling and activating mTOR. It is also vital to the proliferation and differentiation of cells [22-25]. It is often given as a nutritional supplement to oncological patients undergoing CT, especially in cases where mucositis or diarrhoea occur. In relation to mucositis, glutamine stimulates cicatrisation by strengthening the immune system, thereby aiding the recuperation of oral mucus. In the case of diarrhoea, glutamine is able to regenerate the villi by producing improvements in intestinal function [19-25].

As cancerous cells grow rapidly, they have a greater need for amino-acids [26]. Tumours can modify the regulation of the transporters in some amino-acids because of high demand, whilst at the same time improving levels of chemo-resistance [22-25,27,28]. This is particularly evident in the metabolic path of glutamine, and is related to increased proliferation of tumours and a consequent deterioration in the clinical condition of patients [26]. Some cancerous cells can selectively alter the intake of glutamine, thus reducing the effectiveness of any chemotherapeutic drugs administered [22,24,25]. In such cases, glutamine supplements do not produce the desired effect of strengthening patients' immunity, and this stimulates the growth of tumours [24]. As a result, it becomes difficult to decide whether or not to prescribe glutamine supplements for such patients.

In the light of the high rates of gynaecological cancer in certain populations, medical practitioners need to be able to adopt alternative treatments for oncological patients, in order to improve their prognosis

and quality of life. As such, it is essential to carry out further studies concerning the diet of these patients, with a view to identifying other nutritional substances which could be of benefit. It is also important that suitable diagnostic tests be developed, so that alterations in the transport of amino-acids to cancerous cells can be quickly and easily detected, thus making it easier to decide whether or not glutamine supplements should be administered.

## References

1. Bourla AB, Zamarin D (2016) Immunotherapy: New Strategies for the Treatment of Gynecologic Malignancies. *Oncology (Williston Park)* 30: 59-66, 69.
2. Shi VJ, Levy LL, Choi JN (2016) Cutaneous manifestations of nontargeted and targeted chemotherapies. *Semin Oncol* 43: 419-425.
3. Gotimer KF, Bondoc C, Chalas E, Vilella JA (2016) Self Reported Quality of Life Among Patients Who Have Undergone Outpatient IP Chemotherapy for Ovarian Cancer. *Obstetrics and Gynecology* 127: 4S.
4. Chen F, Chen X, Yang D, Che X, Wang J, et al. (2016) Isoquercitrin inhibits bladder cancer progression in vivo and in vitro by regulating the PI3K/Akt and PKC signaling pathways. *Oncol Rep* 36: 165-172.
5. Hernández-Ledesma B, Hsieh CC (2015) Chemopreventive Role of Food-derived Proteins and Peptides: A Review. *Crit Rev Food Sci Nutr*.
6. Berquin IM, Edwards IJ, Chen YQ (2008) Multi-targeted therapy of cancer by omega-3 fatty acids. *Cancer Lett* 269: 363-377.
7. Conklin KA (2002) Dietary polyunsaturated fatty acids: impact on cancer chemotherapy and radiation. *Altern Med Rev* 7: 4-21.
8. Vaughan VC, Hassing MR, Lewandowski PA (2013) Marine polyunsaturated fatty acids and cancer therapy. *Br J Cancer* 108: 486-492.
9. Laviano A, Rianda S, Molfino A, Fanelli FR (2013) Omega-3 fatty acids in cancer. *Curr Opin Clin Nutr Metab Care* 16: 156-161.
10. Fang RH, Zhang L (2016) Nanoparticle-Based Modulation of the Immune System. *Annu Rev Chem Biomol Eng* 7: 305-326.
11. Roudbary M, Daneshmand S, Hajimorad M, Roudbarmohammadip S, Hassan ZM (2015) Immunomodulatory Effect of  $\beta$ -Glucan on Peritoneal Macrophages of Bab1/c Mice. *Pol J Microbiol* 64: 175-179.
12. Choromanska A, Kulbacka J, Rembalkowska N, Pilat J, Oledzki R, et al. (2015) Anticancer properties of low molecular weight oat beta-glucan – An in vitro study. *International Journal of Biological Macromolecules* 80: 23-28.
13. Manuzak JA, Hensley-McBain T, Zevin AS, Miller C, Cubas R, et al. (2016) Enhancement of Microbiota in Healthy Macaques Results in Beneficial Modulation of Mucosal and Systemic Immune Function. *Journal of Immunology* 196: 2401-2409.
14. Chan GC, Chan WK, Sze DM (2009) The effects of beta-glucan on human immune and cancer cells. *J Hematol Oncol* 2: 25.
15. Palucka K, Banchereau J (2012) Cancer immunotherapy via dendritic cells. *Nat Rev Cancer* 12: 265-277.
16. Grivennikov SI, Greten FR, Karin M (2010) Immunity, inflammation, and cancer. *Cell* 140: 883-899.
17. Ballestrero A, Boy D, Moran E, Cirmena G, Brossart P, et al. (2008) Immunotherapy with dendritic cells for cancer. *Adv Drug Deliv Rev* 60: 173-183.
18. Yu AQ, Li L (2016) The Potential Role of Probiotics in Cancer Prevention and Treatment. *Nutr Cancer* 68: 535-544.
19. Sayles C, Hickerson SC, Bhat RR, Hall J, Garey KW, et al. (2016) Oral Glutamine in Preventing Treatment-Related Mucositis in Adult Patients With Cancer: A Systematic Review. *Nutrition in Clinical Practice* 31: 171-179.
20. Chattopadhyay S, Saha A, Azam M, Mukherjee A, Sur PK (2014) Role of oral glutamine in alleviation and prevention of radiation-induced oral mucositis: A prospective randomized study. *South Asian J Cancer* 3: 8-12.
21. Andrade ME, Araújo RS, de Barros PA, Soares AD, Abrantes FA, et al. (2015) The role of immunomodulators on intestinal barrier homeostasis in experimental models. *Clin Nutr* 34: 1080-1087.
22. Wise DR, Thompson CB (2010) Glutamine addiction: a new therapeutic target in cancer. *Trends Biochem Sci* 35: 427-433.
23. Dang CV (2010) Rethinking the Warburg effect with Myc micromanaging glutamine metabolism. *Cancer Res* 70: 859-862.
24. Locasale JW (2013) Serine, glycine and the one-carbon cycle: cancer metabolism in full circle. *Nature Reviews Cancer* 13: 572-583.
25. Phang JM, Liu W, Hancock CN, Fischer JW (2015). Proline metabolism and cancer: emerging links to glutamine and collagen. *Current Opinion in Clinical Nutrition and Metabolic Care* 18: 71-77.
26. Bhutia YD, Babu E, Ramachandran S, Ganapathy V (2015) Amino Acid transporters in cancer and their relevance to "glutamine addiction": novel targets for the design of a new class of anticancer drugs. *Cancer Research* 75: 1782-1788.
27. Wang Q, Hardie RA (2015) Targeting ASCT2-mediated glutamine uptake blocks prostate cancer growth and tumour development. *J Pathol* 236: 278-289.
28. Pochini L, Scalise M, Galluccio M, Indiveri C (2014) Membrane transporters for the special amino acid glutamine: structure/function relationships and relevance to human health. *Frontiers in Chemistry* 2: 1-23.