

# FOODS THAT CAN BE AVOIDED TO MAINTAIN IMMUNITY

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## ABSTRACT:

Foods contain various substances which control the physiological functions of the body, modulating immune responses which is one among the important functions of foods. Immune functions are indispensable for defending the body against attack by pathogens or cancer cells and plays a pivotal role in the maintenance of health. The immune system is supported by the fragile balance that comes with a healthy lifestyle. Adequate sleep, exercise, and, of course, a healthful diet all contribute to maintaining the body's system of defense against illnesses. The immune system acts to guard the host from infectious agents that exist within the environment and from other noxious insults. Nutritional deficiencies seem to weaken the immune system leading to increased disease and mortality. Extrinsic factors can adversely affect immune responses producing states of secondary immunodeficiency and a consequent increased risk of infections. After all, a healthy body and sane mind is all we would like to survive the challenges of this fast paced world. So it is important to take care of a healthy immune system. In addition to knowledge of foods which boosts immunity, it is also important to know the foods that should be avoided to maintain a healthy immune system. This study reviews the foods that can be avoided to maintain immunity and thus promote the immune system.

**KEYWORDS:** Foods, immune system, maintain immunity, health.

## INTRODUCTION

The role of the immune system may be a collection of structures which processes within the body to guard against disease by potentially damaging foreign bodies. Foods contain various substances that control the physiological functions of the body, by modulating immune responses which is one among the foremost important functions of foods. Immune functions are indispensable for defending the body against attack by pathogens or cancer cells and plays a pivotal role in the maintenance of health. Nutrition has an intense impression on immunity. Nutritional deficiencies seem to weaken the immune system leading to increased disease and mortality. Prolonged undernutrition and micronutrient deficiency affects the cytokine response and immune cell trading (Kafeshani, 2014). Malnutrition or calorie restriction can cause reduced activity in immune functions (Kaminogawa and Nanno, 2004). The immune functions are disturbed by malnutrition, aging, physical and mental stress, undesirable lifestyle etc. The ingestion of foods with immune-modulating activities likely to weaken the system. Consumption of high dietary fat increases stored fat mass and is taken into account as a main risk factor for metabolic diseases (Ponnulakshmi *et al.*, 2019). Previous studies have shown that sugar intake in excess suppresses the immune system. When the immune system compromises, we are more likely to urge sick. The digestion and absorption of food are the principal role of the alimentary canal (Corley and Schuppan, 2015). What we eat matters how good our immune system is. Excess consumption of red meat, sugar, saturated fat, low-fibre foods are a number of major factors that affect our immune system. These food items may cause

inflammation within the body, causing several health issues. Doctors say something as simple as eating more fruits ,vegetables will increase immunity. Studies show that Catharanthus roseus (CR) AuNPs contribute to apoptotic cell death in human cervical cancer (HeLa) cells (Ke *et al.*, 2019). Also sesame hampers thyroid cell expansion and initiates apoptosis by hindering STAT-3 translocation (Ma *et al.*, 2019). Marsdenia tenacissima commonly called the Rajmahal Hemp inhibits the cell proliferation and induces apoptosis in laryngeal cancer cells (Hep-2) ('Synthesis of Zinc oxide nanoparticles from Marsdenia tenacissima inhibits the cell proliferation and induces apoptosis in laryngeal cancer cells (Hep-2)', 2019). Clusiaceae are rich during a sort of prenylated xanthenes and therefore the constituents have demonstrated a variety of bioactivities (Jainu, Priya and Mohan, 2018). The aim of this study is to review the foods that can be avoided so as to maintain a healthy immune system and thus promoting it.

### **IMMUNITY:**

Immunity is that the state of protection against communicable disease (Litman, Cannon and Dishaw, 2005). The immune system is an organization of cells and molecules with specialized roles in defending against infection (Delves and Roitt, 2000). There are two subsystems within the immune system which is understood as the innate (non-specific) immune system and the adaptive (specific) immune system . Both these subsystems are closely linked and work together whenever a germ or harmful substance triggers an immune reaction (Sompayrac, 2015). The immune system consists of several biological constitutions activities that protects versus illness. This system is categorized into humoral immunity and cell-mediated immunity or natural immunity.

### **FACTORS AFFECTING IMMUNITY:**

Nutritional deficiencies is one among the major factors round the world. It has led to a weakened immune system not only in adults but also in children. Extrinsic factors can adversely affect immune responses producing states of secondary immunodeficiency and a consequent increased risk of infections. The extrinsic factors are nutritional, environmental factors etc (Chinen and Shearer, 2010). The combination of chronic infection and malnutrition impairs the immune response causing distorted immune cells and increases the inflammatory intermediaries, reduces leukotrienes, weakens the bacterial injection and kills sleep and circadian systems exert a robust regulatory influence on immune functions. The available studies have accumulated quite consistent evidence that sleep indeed essentially contributes regulation of adaptive immunity. Thus the immune system is additionally influenced by sleep-wake cycles and circadian rhythms (Besedovsky, Lange and Born, 2012). Factors like medications ,chemotherapy are also said to immunosuppressants (Saleh, 2020).

### **MODULATION OF IMMUNE SYSTEM BY FOODS:**

IgE-mediated food allergy is in association with certain foods. In young American children cow's milk ,egg, wheat, soy, peanut, etc account for 90% of IgE-mediated allergies (El-Gamal *et al.*, 2011). However any food has the potential to cause allergy. Digestible oligosaccharide raffinose is related to suppression of IgE production suppressing Th2-type immune responses against oral antigen. This is almost like results that dietary raffinose suppresses differentiation of native CD4+ T-cells into Th2 cells because IL-2 is produced by native T-cells - Th1 cells (Sher and Coffman, 1992) . Raffinose suppresses differentiation of naïve T-helper (Th) cells and Th2 cells within the mesenteric lymph nodes (Nagura *et al.*, 2002). Studies indicate that caffeine suppresses antibody production (Horrigan, Kelly and Connor, 2006). However an excessive amount of caffeine intake can interfere with sleep and may end in increased inflammation and compromise immunity. For instance studies indicate caffeine and its major metabolite paraxanthine

suppress neutrophil and monocyte chemotaxis, also suppress the production of the pro-inflammatory cytokine tumour necrosis factor (TNF)- $\alpha$  from human blood.

Monosodium glutamate (MSG) may be a frequently used flavor enhancer and it is one among the foremost applied food additives in modern nutrition worldwide. MSG significantly leads to increased malondialdehyde (MDA) levels, decreased catalase (CAT) activity in thymic tissues. MSG induced oxidative stress within the thymus and spleen results in increasing their sensitivity to lipid peroxidation. On the other hand, stopping the MSG administration resulted in a significant reduction in lipid peroxidation and repletion of antioxidants in the thymus and spleen. These findings support previous study reporting that over-expression of CAT have protected thymocytes against oxidative injury and apoptosis (Tome *et al.*, 2001). MSG administration appeared to contribute impaired histological and immune parameters. MSG consumption has immunotoxic effects in the thymus and spleen in adult rats (Hassan, 2014). Excessive consumption of ginger, red pepper, black pepper especially in combined states (soya sauce) is capable of inducing liver damage and hence should be avoided (Nwaopara *et al.*, 2007). The excessive consumption of ginger, red pepper, black pepper contribute to patchy necrosis of liver hepatocytes. Among these combinations of spices, clove has no effect on liver hepatocytes. This is in line with the study by (Velíšek, Svobodová and Piačková, 2005) that clove has no effect on liver hepatocytes. In vitro evidence advocates that simple sugars decrease white blood cell phagocytosis which probably raises inflammatory cytokine indicators in the blood. Sugars in the form of monosaccharides, oligosaccharides, polysaccharides are vital components infecting microbes and host cells involved in cell signalling associated with modulation of inflammation of all integumental structures (Lloyd *et al.*, 2007). Omega-3 fatty acids generally inhibit immune and inflammatory functions by decreasing lymphocyte proliferation and cytokine production, NK cytotoxicity also antibody production, among other effects (Kleinewietfeld *et al.*, 2013). Animal studies suggest that high salt in the diet increases IL-17-mediated inflammation and worsen autoimmune diseases although predictions on how this may affect humans are seen as preliminary (Kalinski, 2012). Polyunsaturated fatty acids (PUFAs) belonging to the omega-3 family show overall suppressive effects by inhibiting lymphocyte proliferation, antibody and cytokine production, adhesion molecule expression and natural killer cell activity, thereby triggering cell death. Alkaline proteases, one of the most important industrial enzymes are extracted especially from the Intestine of fish (Rengasamy *et al.*, 2016). The omega-6 PUFAs have both inhibitory and stimulatory effects. One potentially harmful effect of fat is the enhancement of the prostaglandin system that feeds into the arachidonic and prostaglandin E<sub>2</sub> (PGE<sub>2</sub>) pathways (Qin, 2002). Hyaluronic acid (HA) is an extracellular matrix protein, often associated with various diseases that are associated with inflammation and inflammatory responses (Mohan, Veeraraghavan and Jainu, 2015).

People also consumed many kinds of chemicals in foods, drink, medicine and many other forms every day. The impacts of artificial sweeteners are less clear, provocative, yet highly limited. Children should avoid sugary soft drinks and junk foods instead, consume healthy meals and eat a full breakfast daily (Shukri *et al.*, 2016). Evidence implicates saccharin and sucralose as contributors to Crohn's and Ulcerative Colitis that interfere with homeostatic inactivation of digestive proteases (Romeo *et al.*, 2007). Alcohol seems to impair the ability of white blood cells to migrate to sites of injury and infection and also induce functional abnormalities of T and B, natural killer cells, monocytes/macrophages causing alteration of cytokine production (Junker *et al.*, 2012). Cell-culture models found elements in gluten stimulate inflammation through TLR4 (Pompéia *et al.*, 2000)

### **FOODS TO IMPROVE IMMUNITY:**

The micronutrients are important to reinforce immune function which includes vitamins A, C, E, and B<sub>6</sub>, folate, iron, zinc, and selenium. Studies show that these are essentially important for maintenance of immune function. These vitamins are found in fruits and veggies (Gleeson, Nieman and Pedersen, 2004).

Consumption of sufficient calories, especially protein intake is important for optimum immune function. Phytochemicals are defined as bioactive non-nutrient plant compounds in fruits, vegetables, grains, and other plant foods that are linked to reducing the danger of major chronic diseases (Menon, V and Gayathri, 2016). Ginger is the mainly widespread spice and herbal remedies utilized in the world. Zingerone, a key component in ginger, exhibits anticancer effect toward DMBA-induced mammary cancer in SD animals and Michigan cancer foundation-7 mammary cancer cells (Gan *et al.*, 2019). A study showed that active constituents of ginger prevents UVB radiation mediated inflammation and oxidative stress through modulating NrF2 signaling in human epidermal keratinocytes (Chen *et al.*, 2019). Vitamins, minerals and oligosaccharides increase T cells and augment their proliferative response. Siberian ginseng may be a perennial herb, which belongs to the family of Araliaceae aromatic flowering plants and it has also been extensively reported to take care of homeostasis of the immune system (Wu *et al.*, 2019). Eugenol may be a major bioactive constituent present within the essential oils with numerous pharmacological benefits including neuroprotective activity (Li *et al.*, 2020). Nutmeg, a spice seed extract and also strawberry extract exhibits cytotoxic activity (G *et al.*, 2018; Rengasamy *et al.*, 2018). Hence it is important to boost immunity since nutrition and other lifestyle measures influence immune strength and susceptibility to infectious diseases.

## CONCLUSION:

Food production agencies should take heed and potentially reduce the frequency/level of MSG in addition to food products and individuals should restrict their dietary intake of foods containing this flavor enhancer. Also sugar intake, beverages high in sugar, refined carbohydrates, body processes as sugar thus reducing body's ability to ward off disease. Ingestion of foods does not always change immune parameters. Supplementation with single or multiple micronutrients may enhance the immune functions even in healthy individuals. On the other hand excess amount of some nutrients may impair the immune functions. Further studies are required on scientific data on foods. This study is limited to focus

on the foods that suppress the immune system. As the world battles the deadliest virus attacks of all time, this phase has been an awakening for most of them. With no accurate line of treatment or vaccination, the only way to stay safe is by building a rock solid immune system.

## AUTHOR CONTRIBUTIONS

All authors have contributed equally to the study.

## CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

## REFERENCES:

- [1] Besedovsky, L., Lange, T. and Born, J. (2012) 'Sleep and immune function', *Pflügers Archiv - European Journal of Physiology*, pp. 121–137. doi: 10.1007/s00424-011-1044-0.
- [2] Chen, F. et al. (2019) '6-shogaol, a active constituents of ginger prevents UVB radiation mediated inflammation and oxidative stress through modulating NrF2 signaling in human epidermal keratinocytes (HaCaT cells)', *Journal of Photochemistry and Photobiology B: Biology*, p. 111518. doi: 10.1016/j.jphotobiol.2019.111518.
- [3] Chinen, J. and Shearer, W. T. (2010) 'Secondary immunodeficiencies, including HIV infection', *Journal of Allergy and Clinical Immunology*, pp. S195–S203. doi: 10.1016/j.jaci.2009.08.040.
- [4] Corley, D. A. and Schuppan, D. (2015) 'Food, the Immune System, and the Gastrointestinal Tract', *Gastroenterology*, pp. 1083–1086. doi: 10.1053/j.gastro.2015.03.043.

- [5] Delves, P. J. and Roitt, I. M. (2000) 'The Immune System', *New England Journal of Medicine*, pp. 37–49. doi: 10.1056/nejm200007063430107.
- [6] El-Gamal, Y. M. et al. (2011) 'Immunomodulatory effects of food', *Egyptian Journal of Pediatric Allergy and Immunology (The)*. ajol.info, 9(1). doi: 10.4314/ejpai.v9i1.
- [7] Gan, H. et al. (2019) 'Zingerone induced caspase- dependent apoptosis in MCF- 7 cells and prevents 7,12- dimethylbenz(a)anthracene- induced mammary carcinogenesis in experimental rats', *Journal of Biochemical and Molecular Toxicology*. doi: 10.1002/jbt.22387.
- [8] Gleeson, M., Nieman, D. C. and Pedersen, B. K. (2004) 'Exercise, nutrition and immune function', *Journal of Sports Sciences*, pp. 115–125. doi: 10.1080/0264041031000140590.
- [9] G, R. et al. (2018) 'CYTOTOXICITY OF STRAWBERRY EXTRACT ON ORAL CANCER CELL LINE', *Asian Journal of Pharmaceutical and Clinical Research*, p. 353. doi: 10.22159/ajpcr.2018.v11i9.25955.
- [10] Hassan, Z. A. (2014) 'The Effects of Monosodium Glutamate on Thymic and Splenic Immune Functions and Role of Recovery (Biochemical and Histological study)', *Journal of Cytology & Histology*. doi: 10.4172/2157-7099.1000283.
- [11] Horrigan, L., Kelly, J. and Connor, T. (2006) 'Immunomodulatory effects of caffeine: Friend or foe?', *Pharmacology & Therapeutics*, pp. 877–892. doi: 10.1016/j.pharmthera.2006.02.002.
- [12] Jainu, M., Priya, V. and Mohan, S. (2018) 'Biochemical evidence for the antitumor potential of *Garcinia mangostana* Linn. On diethylnitrosamine-induced hepatic carcinoma', *Pharmacognosy Magazine*, p. 186. doi: 10.4103/pm.pm\_213\_17.
- [13] Junker, Y. et al. (2012) 'Wheat amylase trypsin inhibitors drive intestinal inflammation via activation of toll-like receptor 4', *The Journal of Experimental Medicine*, pp. 2395–2408. doi: 10.1084/jem.20102660.
- [14] Kafeshani, M. (2014) 'Diet and immune system', *Immunopathologia Persa*. Nickan Research Institute, 1(1), p. e04.
- [15] Kalinski, P. (2012) 'Regulation of Immune Responses by Prostaglandin E2', *The Journal of Immunology*, pp. 21–28. doi: 10.4049/jimmunol.1101029.
- [16] Kaminogawa, S. and Nanno, M. (2004) 'Modulation of Immune Functions by Foods', *Evidence-Based Complementary and Alternative Medicine*, pp. 241–250. doi: 10.1093/ecam/neh042.
- [17] Ke, Y. et al. (2019) 'Photosynthesized gold nanoparticles from *Catharanthus roseus* induces caspase-mediated apoptosis in cervical cancer cells (HeLa)', *Artificial Cells, Nanomedicine, and Biotechnology*, pp. 1938–1946. doi: 10.1080/21691401.2019.1614017.
- [18] Kleinewietfeld, M. et al. (2013) 'Sodium chloride drives autoimmune disease by the induction of pathogenic TH17 cells', *Nature*, pp. 518–522. doi: 10.1038/nature11868.
- [19] Litman, G. W., Cannon, J. P. and Dishaw, L. J. (2005) 'Reconstructing immune phylogeny: new perspectives', *Nature reviews. Immunology*, 5(11), pp. 866–879.
- [20] Li, Z. et al. (2020) 'Apoptotic induction and anti-metastatic activity of eugenol encapsulated chitosan nanopolymer on rat glioma C6 cells via alleviating the MMP signaling pathway', *Journal of Photochemistry and Photobiology B: Biology*, p. 111773. doi: 10.1016/j.jphotobiol.2019.111773.
- [21] Lloyd, D. H. et al. (2007) 'Role of sugars in surface microbe?host interactions and immune reaction modulation', *Veterinary Dermatology*, pp. 197–204. doi: 10.1111/j.1365-3164.2007.00594.x.

- [22] Ma, Y. et al. (2019) 'Sesame Inhibits Cell Proliferation and Induces Apoptosis through Inhibition of STAT-3 Translocation in Thyroid Cancer Cell Lines (FTC-133)', *Biotechnology and Bioprocess Engineering*, pp. 646–652. doi: 10.1007/s12257-019-0151-1.
- [23] Menon, A., V. V. P. and Gayathri, R. (2016) 'PRELIMINARY PHYTOCHEMICAL ANALYSIS AND CYTOTOXICITY POTENTIAL OF PINEAPPLE EXTRACT ON ORAL CANCER CELL LINES', *Asian Journal of Pharmaceutical and Clinical Research*, p. 140. doi: 10.22159/ajpcr.2016.v9s2.13313.
- [24] Mohan, S. K., Veeraraghavan, V. P. and Jainu, M. (2015) 'Effect of pioglitazone, quercetin, and hydroxy citric acid on vascular endothelial growth factor messenger RNA (VEGF mRNA) expression in experimentally induced nonalcoholic steatohepatitis (NASH)', *TURKISH JOURNAL OF MEDICAL SCIENCES*, pp. 542–546. doi: 10.3906/sag-1404-136.
- [25] Nagura, T. et al. (2002) 'Suppressive effect of dietary raffinose on T-helper 2 cell-mediated immunity', *British Journal of Nutrition*, pp. 421–426. doi: 10.1079/bjn2002666.
- [26] Nwaopara, A. O. et al. (2007) 'The Combined Effects of Excessive Consumption of Ginger, Clove, Red Pepper and Black Pepper on the Histology of the Liver', *Pakistan Journal of Nutrition*, pp. 524–527. doi: 10.3923/pjn.2007.524.527.
- [27] Pompéia, C. et al. (2000) 'Effect of fatty acids on leukocyte function', *Brazilian Journal of Medical and Biological Research*, pp. 1255–1268. doi: 10.1590/s0100-879x2000001100001.
- [28] Ponnulakshmi, R. et al. (2019) 'In silico and in vivo analysis to identify the antidiabetic activity of beta sitosterol in adipose tissue of high fat diet and sucrose induced type-2 diabetic experimental rats', *Toxicology Mechanisms and Methods*, pp. 276–290. doi: 10.1080/15376516.2018.1545815.
- [29] Qin, X. F. (2002) 'Impaired inactivation of digestive proteases by deconjugated bilirubin: The possible mechanism for inflammatory bowel disease', *Medical Hypotheses*, pp. 159–163. doi: 10.1016/s0306-9877(02)00243-8.
- [30] Rengasamy, G. et al. (2016) 'Characterization, Partial Purification of Alkaline Protease from Intestinal Waste of *Scomberomorus Guttatus* and Production of Laundry Detergent with Alkaline Protease Additive', *INDIAN JOURNAL OF PHARMACEUTICAL EDUCATION AND RESEARCH. ASSOC PHARMACEUTICAL TEACHERS INDIA AL-AMEEN COLL PHARMACY, OPP LALBACH MAIN ...*, 50(2), pp. S59–S67.
- [31] Rengasamy, G. et al. (2018) 'Cytotoxic and apoptotic potential of *Myristica fragrans* Houtt. (mace) extract on human oral epidermal carcinoma KB cell lines', *Brazilian Journal of Pharmaceutical Sciences*. doi: 10.1590/s2175-97902018000318028.
- [32] Romeo, J. et al. (2007) 'Moderate alcohol consumption and the immune system: A review', *British Journal of Nutrition*, pp. S111–S115. doi: 10.1017/s0007114507838049.
- [33] Saleh, N. (2020) 'Pembrolizumab Alone or With Chemotherapy for PD-L1--Positive NSCLC?', *Oncology*. [cancernetwork.com](https://www.cancernetwork.com/wclc/pembrolizumab-alone-or-chemotherapy-pd-l1positive-nsclc), 34(5). Available at: <https://www.cancernetwork.com/wclc/pembrolizumab-alone-or-chemotherapy-pd-l1positive-nsclc>.
- [34] Sher, A. and Coffman, R. L. (1992) 'Regulation of Immunity to Parasites by T Cells and T Cell-Derived Cytokines', *Annual Review of Immunology*, pp. 385–409. doi: 10.1146/annurev.iy.10.040192.002125.
- [35] Shukri, N. M. M. et al. (2016) 'Awareness in childhood obesity', *Research Journal of Pharmacy and Technology*, p. 1658. doi: 10.5958/0974-360x.2016.00334.6.

- [36] Sompayrac, L. M. (2015) *How the Immune System Works*. John Wiley & Sons.
- [37] ‘Synthesis of Zinc oxide nanoparticles from *Marsdenia tenacissima* inhibits the cell proliferation and induces apoptosis in laryngeal cancer cells (Hep-2)’ (2019) *Journal of photochemistry and photobiology. B, Biology*. Elsevier, 201, p. 111624.
- [38] Tome, M. E. et al. (2001) ‘Catalase-overexpressing thymocytes are resistant to glucocorticoid-induced apoptosis and exhibit increased net tumor growth’, *Cancer research*, 61(6), pp. 2766–2773.
- [39] Velíšek, J., Svobodová, Z. and Piačková, V. (2005) ‘Effects of Clove Oil Anaesthesia on Rainbow Trout (*Oncorhynchus mykiss*)’, *Acta Veterinaria Brno*, pp. 139–146. doi: 10.2754/avb200574010139.
- [40] Wu, F. et al. (2019) ‘Biologically synthesized green gold nanoparticles from Siberian ginseng induce growth-inhibitory effect on melanoma cells (B16)’, *Artificial Cells, Nanomedicine, and Biotechnology*, pp. 3297–3305. doi: 10.1080/21691401.2019.1647224.