

EXPLORING THE ROLE OF FRUITS, VEGETABLES AND ESSENTIAL OILS IN STRENGTHENING THE IMMUNE SYSTEM: A MINI REVIEW

¹Anosike F.C., ²Uwandu A.C., ²Benneth I.C. and ¹Nkwocha G.A.

¹Department of Agriculture, Alex Ekwueme Federal University Ndufu Alike, Abakaliki, Ebonyi State, Nigeria

²Department of Human Nutrition and Dietetics, Alex Ekwueme Federal University Ndufu Alike, Abakaliki, Ebonyi State, Nigeria

*Corresponding Author Email Address: francisanosike867@yahoo.com

<https://orcid.org/0000-0002-8559-7664>

ABSTRACT

Fruits and vegetables are rich sources of bioactive compounds, including vitamins, minerals, dietary fiber, carotenoids, flavonoids, and polyphenols, which possess strong antioxidant properties. These compounds help mitigate oxidative stress caused by reactive oxygen species, thereby supporting immune function. Essential oils and their volatile constituents have also been reported to exhibit antimicrobial, anti-inflammatory, anti-allergic, and immunomodulatory effects. However, in conditions such as autoimmune diseases, immunodeficiency disorders, and allergic reactions, immune function may be impaired, increasing susceptibility to infections and inflammatory conditions. Evidence from existing literature suggests that regular consumption of fruits and vegetables, alongside the appropriate use of essential oils, may enhance immune response and reduce inflammation and oxidative damage. This review highlights the importance of fruits, vegetables, and essential oils as plant-based interventions that may improve immunological response. This mini review explores the potential role of fruits, vegetables, and essential oils in strengthening the immune system, particularly in individuals with compromised immunity.

Keywords: Essential oil, fruits, immune system, vegetables

INTRODUCTION

Humans and other mammals exist in environments heavily populated with pathogenic microorganisms, toxins, and harmful chemicals that can disrupt normal physiological functions and pose significant threats to health (Chaplin, 2010; Janik *et al.*, 2020; and Mercer, 2021). These agents may enter the body through contaminated food, environmental exposure, or contact with infected surfaces, thereby triggering immune responses. The immune system is a complex network of cells, tissues, and organs that protects the body against infections and harmful substances. It functions through coordinated immunological responses to pathogens, toxins, and foreign bodies. Broadly, immunity can be classified into innate and adaptive components. (Calder, 2022). The innate immune system serves as the first line of defense, providing rapid, non-specific responses through physical barriers such as the skin and mucous membranes, as well as immune cells that respond immediately to invading agents (Moreb *et al.*, 2021). In contrast, the adaptive immune system is highly specific and involves the activation and proliferation of lymphocytes that target particular antigens. Although slower to develop, adaptive immunity generates immunological memory, enabling a faster and more effective response upon subsequent exposure to the same pathogen (Janeway *et al.*, 2001). Thus, immunity is the ability of an

organism to defend against pathogenic microorganisms and harmful substances in the body by fighting against them or through vaccination to prevent disease (Macedo *et al.*, 2019). The immune system consists of cells, organs, proteins, skin, mucous membranes and the lymphatic system that operate as a physical barrier against microorganisms. Special cells, tissues and organs make up the lymphatic system, which work together to defend the body. White blood cells (leukocytes) are produced in the bone marrow, the spleen, the thymus and the tonsils; all are part of the immune system (Janeway *et al.*, 2001). The immune system detects and reacts to bacteria, viruses, foreign substances and toxins that are harmful to the organism's health. Thus, its major role is to protect the organism from such intruders, thereby sustaining the body's wholeness in terms of health and survival. When the immune system meets pathogenic organisms like bacteria, viruses or parasites, the system mounts an immune response to oppose them. The immune system performs this function by recognizing self from non-self, dead or damaged cells through acknowledging proteins found on the surface of all cells through the assistance of histocompatibility complex molecules (Jiang & Chess, 2009). These molecules act as identification tags and will not attack cells bearing these genetically determined markers. Non-self and distinct cells, microbes and foreign bodies are identified and engulfed and digested with the assistance of white blood cells (macrophages and lymphocytes) or through the production of antibodies by the B lymphocytes that secrete proteins known as immunoglobulins (Ig) (Nicholson, 2016). These proteins circulate within the bloodstream and spread throughout the body fluids, where they attach themselves particularly to the foreign antigens that prompt their production. The foreign bodies (microbes and toxins) are inactivated, destroyed and cleared from the system by blocking their ability to bind to receptors on the host cells without damaging the host cells and tissues (self-tolerance). The T-lymphocytes, especially CD4+ T and CD8+ cytotoxic T cells, exhibit cell-mediated immune responses in which they neutralize host cells directly in response to foreign antigens on their surfaces (Alberts *et al.*, 2002 and Peterfalvi *et al.*, 2019). The following was reported to trigger immune responses as discussed below

Allergic Reactions

Allergic reactions occur when the immune system mounts an exaggerated or hypersensitive response to substances that are typically harmless to most individuals. These substances, known as allergens, can trigger immune responses that may result in inflammation and damage to normal tissues. Common manifestations of allergic reactions include symptoms such as coughing, a runny nose, skin irritation, and gastrointestinal

disturbances, as well as more severe systemic responses like anaphylaxis. These reactions may arise from exposure to allergens through inhalation, ingestion, or skin contact. Common allergens include environmental agents such as dust, pollen, and smoke, as well as food substances, insect stings, and mite-derived particles. In some individuals, repeated or intense allergic responses may progress into chronic allergic conditions, including hay fever (allergic rhinitis), eczema (atopic dermatitis), urticaria (hives), and asthma. Allergic reactions can affect individuals across all age groups, sexes, races, and socioeconomic backgrounds (Platts-Mills & Woodfolk, 2011).

Antigens

Antigens are substances the body sees as foreign bodies and harmful to the body cells. The immune system triggers a response to help fight such antigens. Antigens can be in the form of dust particles, food components, microbes and cancer cells, etc.

Autoimmune Disorders

Autoimmune disorders occur when the immune system wrongly attacks our body cells. When the immune system can't tell the difference between self and non-self, it sends out autoantibodies to fight its own healthy cells. Autoimmune disorders usually occur when T cells and B cells are over-activated and recruited to cause self-tissue damage. Rheumatoid arthritis, Type 1 diabetes, thyroid disease, systemic lupus erythematosus, inflammatory bowel disease and celiac disease are all autoimmune illnesses (Janeway *et al.*, 2001 and Lang *et al.*, 2007). The major causes of autoimmune disorders are believed to be genetic and environmental factors; others include high hormone levels in women, stress, responses of the immune system mistakenly attacking healthy cells and tissues, and injury, especially in the joints, which are among the suspected causes (Angum *et al.*, 2020).

Genetic factors

Breakdown of the immune system is associated with the possibility of developing a disease condition due to inherited genetic variations. Variations in genes that code for antigens that control activation and suppression of immune cells, such as the PTPN22 gene outside the main region of the histocompatibility complex, may play a significant role in some autoimmune diseases, increasing susceptibility (Brownlie & Salmond, 2024). Certain Human Leukocyte Antigen (HLA) genes, such as HLA-DQ8 for type 1 diabetes and celiac disease, HLA-DR4 for rheumatoid arthritis and others, may increase the risk of autoimmune disease by triggering immune responses and attacks (Bodis *et al.*, 2018).

Environmental factors

Environmental triggers such as infection, smoking, certain medications, diet, hormonal changes, pollutants, stress and gut microbiome changes may interact with genetic susceptibility to initiate autoimmune disease (Maruvada & Miller, 2026).

Inflammation

In a normal immune system, inflammation functions as a protective response to infections, like pathogens or toxic substances, that may result in damaged tissues due to uncontrolled and unusual growth of self-cells. Redness, swelling, heat, pain and loss of tissue function are all symptoms of inflamed tissues. Antigens and foreign bodies that are damaging to the body are removed via inflammation

with the help of the innate and adaptive immune system. The immune system initiates inflammatory cell pathways and cytokines that respond to trap bacteria and other objects and start up a healing process. Inflammation helps prevent infection in the body and restores normal tissue homeostasis (Chen *et al.*, 2018); however, in the autoimmune system, the immune system attacks itself, triggering activation of immune cells (T cells, B cells, macrophages), leading to the overproduction of cytokines and attack on healthy tissues (O'Shea *et al.*, 2002).

Immunodeficiency Disorders

Immunodeficiency disorder is the inability of the immune system to defend itself from invading foreign bodies. Immunodeficiency disorders involve a series of steps that engage both the adaptive and innate immune system. The immune system's adaptive response is usually not reactive to self, but under certain conditions, like cancer, diseases and long-term use of drugs, it can activate the innate immune system's cells and interrupt the adaptive immune system's autoreactive cells, leading to a state of inactivity and initiating autoimmune disease (Lang *et al.*, 2007). Other causes of immunodeficiency disorders include mutations in specific genes, disorders of innate immunity (neutrophil disorders and natural killer deficiency), and environmental factors, as reported by Knight (2012) and Marson *et al.* (2015). These disorders prevent the body from fighting infections, diseases and abnormal cells that affect the body, thus making the body prone to attack by viruses and bacterial infections. Immunodeficiency disorders can be genetic (born with) or acquired (Cooper *et al.*, 1999). Fernandez (2021) reported that in most cases, people with immunodeficiency disorders may also suffer autoimmune disorders. Genetic immunodeficiency disorders, commonly known as primary immunodeficiencies, include Common Variable Immunodeficiency (CVID), Severe Combined Immunodeficiency (SCID) or alymphocytosis, and Chronic Granulomatous Disease (CGD). Acquired immunodeficiency disorders include Acquired Immune Deficiency Syndrome (AIDS) (Janeway *et al.*, 2001).

Types of Immunity

It is imperative here to briefly describe the types of immunity that protect the body before discussing how the immune system can be strengthened and the role of fruits, vegetables and volatile oils in boosting immunity.

Innate Immunity

Humans and lower animals are born with innate immunity against pathogens and disease, such as the skin and mucous membranes. The first line of protection is innate immunity. The innate immune system protects the body against microbes and infection. The innate immune system is made up of white blood cells, complement C1-C4 proteins that bind to pathogens and cytokines that attract immune cells to the site of infection (Dunkelberger & Song, 2010). The innate immunity response is generally non-specific to a particular pathogen and lacks the ability to remember or build immunological recollection against recurring pathogens (Janeway *et al.*, 2001). The skin and other epithelial surfaces serve as a barrier against invading pathogens; however, when pathogens break through these barriers and infect the body, the innate immune system initiates responses that recognize molecules present in the pathogens but absent in the host. The response instigates inflammatory and phagocytosis processes at the site of infection to get rid of the pathogens from the body (Alberts *et al.*,

2002).

Adaptive (Acquired) Immunity

The adaptive immune system is a highly coordinated defense network that targets pathogens, clears infections and retains immunological memory of past threats. The body develops immunity when exposed to diseases and builds up immunological recollection with the assistance of T and B cells (lymphocytes). The adaptive immune response is specific to pathogens, meaning that it attacks non-self pathogens (Janeway *et al.*, 2001). Adaptive immune responses can be categorized into two types: cell-mediated immune responses initiated by T cells or antibody responses initiated by B cells (Abbas *et al.*, 2021). In cell-mediated immune responses, the T cells are activated to react directly against foreign antigens, while in antibody responses, the cells produce immunoglobulins, antibodies that bind to the antigen that initiated their production, thereby inactivating the foreign bodies and blocking their ability to bind to receptors on host cells, making it possible for phagocytosis to take place (Alberts *et al.*, 2002). Figure 1 below presents how lymphocytes carry out both types of responses. Here, the lymphocytes are responding to a viral infection. In one class of response, B cells secrete antibodies that neutralize the virus. In the other, a cell-mediated response, T cells kill the virus-infected cells. Figure 1 illustrates the responses in the immune system.

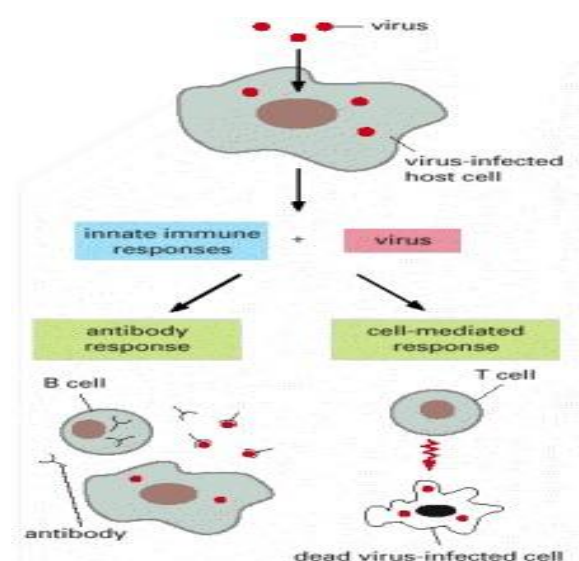


Figure 1: Responses in the immune system

Source: Alberts *et al.*, (2002)

Passive Immunity

Passive immunity can be acquired in two ways: natural or artificial. Passive immunity provides instant protection but is usually brief because the transferred antibodies are gradually broken down and the recipient's immune system does not store memory cells.

Natural passive immunity

The placenta (mainly antibodies) or breast milk (mainly IgA antibodies) can convey natural passive immunity from the mother to the newborn baby.

Artificial passive immunity

Artificial passive immunity can be developed when a person receives an immunization against a disease or medication treatments like antivenom for snake bites and immunoglobulin injections for diseases like rabies, hepatitis B and tetanus (Slifka & Amanna, 2018).

Strengthening the Immune System

A weakened immune system makes the body sick frequently and may result in severe deterioration of health and death in most cases. Malnutrition, especially micronutrient deficiency, among other disease conditions and factors, can have a devastating effect on a compromised immune system. Thus, a compromised immune system will have adverse consequences on both innate and adaptive immunity (Franca *et al.*, 2009). People with a compromised immune system may find it difficult to tackle infections that invade the body system and may not recover from such infections until the immune system improves (Baidya & Sethy, 2020). It is therefore important to strengthen the immune system. Fruits and vegetables are reported to be rich in carotenoids, fiber, flavonoids, minerals, photochemicals especially antioxidants, polyphenols vitamins and water that are naturally present that help regulate and strengthen the immune system providing nutrients and reducing chronic inflammation (Gibson *et al.*, 2012 and Slavin and Lioyd, 2012) while essential oil and their volatile constituents have been reported to have anti-allergic, anticancer, anti-inflammatory and immunomodulatory effects (Peterfalvi *et al.*, 2019; Edris, 2007 and Sandner *et al.*, 2020). These components and qualities help strengthen the immune system by preventing the negative effects of reactive oxygen species, which are particularly harmful to immunocompromised people and the elderly (Pangrazzi, 2019). Figure 2 presents the basic components of the immune system, including key micronutrients that contribute to immune function, adapted from Gombart *et al* (2020).



Figure 2: Basic components of the immune system including key micronutrients

The role of Fruits and Vegetables

Our health will significantly improve when we choose to eat well, especially plant-based foods (Liu, 2013). A strong immune system protects the body against diseases such as heart disease, cancer, stroke, diabetes and age-related diseases, as well as infections and other foreign bodies. Among other factors that have been reported to cause variations in immune response, diet has been recognized as an important factor because it plays an important role and supplies nutrients that help the immune system (Calder, 2022). An insufficient diet will predispose compromised individuals to infections. Gibson *et al.* (2012) reported that fruits and vegetables are rich in micronutrients and antioxidants. Micronutrient deficiencies may impair immune system function due to the large gap between fruit and vegetable consumption and the recommended dietary allowance. Consuming fruits and vegetables

rich in micronutrients can help boost the immune system, increase antibody production and activities of the innate and adaptive immune system, and prevent non-communicable and less curable diseases like cancer and cardiovascular risk factors (Dhandevi & Rajesh, 2015; Pangrazzi, 2019). Many researchers have reported the effect of fruits and vegetable consumption on immune system response. It is important to report some of their findings to support further the claim that fruit and vegetable consumption boosts immune response. Insera *et al.* (1999) investigated the effect of eating fruits and vegetable extracts on the immunological function of elderly smokers and non-smokers. Their results revealed a significant increase in serum antioxidant activities, T and B cells from peripheral blood mononuclear cells, natural killer cells and interleukin-2 (IL2) levels. They concluded that fruit and vegetable consumption improved immunological response in elderly subjects and improved interleukin-2 (IL-2) levels in elderly smokers. Moreb *et al.* (2021) investigated the importance of eating fruits and vegetables in boosting the immune system, especially in people with underlying health conditions during COVID 19. Their study suggested that fruit and vegetable-rich diets will be beneficial in improving the immune response of people with underlying health conditions and also help reduce the risk of severe COVID-19 complications and infections. Miles and Calder (2021) examined the effect of citrus fruit juices and bioactive components on inflammation and immunity. Their study disclosed that citrus fruit juice consumption helps reduce inflammatory markers; prevent excessive and uncontrolled inflammation that could damage host cells; control oxidative stress; and improve the innate and adaptive immune system. They also identified two important nutrients in fruit juice, vitamin C and folate, that are probably relevant to the immune response. Fresh fruits and vegetables, as well as processed forms such as frozen, canned, cooked, 100% fruit juices, 100% vegetable juices and dry fruits contain these nutrients and other bioactive substances (Liu, 2013). Other significant roles of fruits and vegetables in immune system response are well documented (Ali *et al.*, 2019; Baidya & Sethy, 2020; Hosseini *et al.*, 2018; Suardi *et al.*, 2021). A diet rich in fruits and vegetables is a pillar for a stronger immune system because of the nutrients and bioactive compounds that fruits and vegetables can supply to the body. Some vital, key important nutrients present in fruits and vegetables and the roles they play in boosting immunity are briefly described below:

Vitamin A

Vitamin A helps support phagocytic function, increases natural killer cells and enhances T helper type 1 and T helper type 2 mediated immunity as well as interleukin 2 (IL2) levels. Vitamin A deficiency is often associated with infectious disease (Semba, 1998); however, vitamin A supplementation may assist in reducing the rate of infections and recovery from disease, especially in children (Calder, 2013). Vitamin A is involved in the morphological formation of the epithelium, protects the epithelial tissues and maintains integrity against infections (Huang *et al.*, 2018). Vitamin A enhances B and T-cell homing in the gut and supports B-cell activity in immunoglobulin synthesis (Calder, 2022). Vitamin A has been reported to help enhance the anti-inflammatory response of organisms (Huang *et al.*, 2018) and support the innate and adaptive immune system (Gombart *et al.*, 2020).

Vitamin C

Vitamin C helps immune cells work properly, including neutrophils, monocytes and natural killer cells. Vitamin C also prevents

oxidative stress and inflammation and enhances antibody production; T cells, especially cytotoxic T cells, promote collagen synthesis and wound healing (Calder, 2022). Vitamin C also supports epithelial barrier function against pathogens and phagocytosis (Anitra & Silvia, 2017). Vitamin C has been reported to enhance keratinocyte differentiation and lipid synthesis, as well as fibroblast proliferation and migration. These processes are essential for maintaining an effective epidermal barrier in healthy adult skin (Carr & Maggini, 2017). Vitamin C also enhances phagocytosis, microbial killing involved in apoptosis and clearance of spent neutrophils from the site of infection by macrophages (Carr & Maggini, 2017).

Vitamin D

Vitamin D can be beneficial in several ways in both the innate and adaptive immune system (Hewison, 2012). It has been reported that immune cells can synthesize vitamin D, which implies that vitamin D may likely have immunoregulatory properties (Calder, 2013). Sufficient vitamin D intake from fruits and vegetables can initiate antimicrobial production through phagocytosis, superoxide synthesis, production of bacteria-killing cells, and prevention of autoimmunity and other immune-mediated diseases.

Vitamin E

Vitamin E is an important micronutrient found in fruits and vegetables. It has been reported to enhance host resistance to influenza and upper respiratory infections, especially in compromised older adults, and to improve T-cell-mediated function, Delayed Type Hypersensitivity (DTH) response, and IL-2 production (Pae *et al.*, 2012). Vitamin E also protects the cells against oxidative damage and supports the production of antibodies and natural killer (NK) cells. Vitamin E also enhances lymphocyte proliferation and T-cell-mediated functions and optimizes T-helper type 1 (Th1) response (Haryanto *et al.*, 2015).

Zinc

Zinc is a trace element present in most fruits and vegetables and is needed in the body in minute amounts for normal body functioning. Zinc is essential for immune system function. Its lack can cause growth retardation and immunological dysfunction, particularly in developing countries where zinc is inadequate (Prasad, 2008). Zinc assists in the maintenance of skin and mucous membrane integrity and aids in phagocytosis and the production of NK cells and antibodies. Zinc also act as an anti-inflammatory agent, help to modulate cytokine release by dampening the development of pro-inflammatory T-helper type 17 (Th17) and T-helper type 9 (Th9) cells (Wu *et al.*, 2019) and also sway the production of cytokines such as interleukin-2 (IL-2), interleukin -6 (IL-6) (Wessel & Rink, 2019) and tumor necrosis factor (TNF- α) (Foster & Samman, 2012).

Selenium

Selenium is an important micronutrient present in fruits and vegetables that enhances immune system function. Selenium aids in the improvement of immune response to vaccines, supports the development and activity of NK cells, T cells and antibodies while reducing oxidative stress and inflammation (Calder, 2022). Selenium helps to maintain antibody levels (Saeed *et al.*, 2016) and increases interferon gamma production by immune cells (Haryanto *et al.*, 2015). Table 1 presents nutrients present in fruits and vegetables that boost immunity, as adapted from Baidya and

Sethy (2020).

Table 1: Nutrients in fruits and vegetables that boost immunity

Table 1: Nutrients in Fruits and Vegetables that boost immunity		
Fruit and vegetables		Nutrients
Citrus	Lemons	Vitamin C, Folic acid, Potassium, Pectin
	Oranges	Fiber, Calcium, Magnesium, Potassium, Vitamin C
	Lime	Calcium, Magnesium, Potassium, Vitamin C
	Grape	Fiber, Calcium, Magnesium, Potassium, Vitamin C
Aonla		Calcium, Magnesium, Potassium, Vitamin C
Jamun		Fiber, Calcium, Magnesium, Potassium, Vitamin C
Watermelon		Potassium, Vitamin C
Papaya		Vitamin C, Polyphenol, Tannins,
Banana		Phyllemblic acid, Gallic, Ellagic Acid
Berries		Calcium, Iron, Potassium, Vitamin C
Pineapple		Vitamin A, Vitamin C, Vitamin B6
Broccoli		Vitamins A, B, C, Carotene, Folic Acid
Brussel sprouts		Iron, Potassium, Calcium,
Cauliflower		Magnesium
Carrot		Vitamin C, Vitamin A, Potassium,
Spinach		Manganese, Fibers
Onions		Vitamin C, Malic Acid, Bromelain
		Potassium, Magnesium,
Tomatoes		Calcium, Zinc, Selenium
		Alpha-Lipoic Acid, Vitamin C
Garlic		Glutathione,
		Choline, Vitamin K, Vitamin C
Ginger		B-Carotenes,
		Vitamin C, Fiber, Vitamin A
Turmeric		Vitamin K, Flavonoids,
		Carotenoids, Vitamins C and E
		Organosulfur, Fructans, Selenium, Sulfur compounds,

		Zinc, Vitamin C Lycopene, Vitamin A, Vitamin C, Vitamin B, Potassium, Chromium Allicin Vitamins B3, B6, Iron, Potassium, Vitamin C, Magnesium, Phosphorus, Riboflavin Curcumin, Calcium, Potassium, Iron, Thiamine, Riboflavin, Niacin, Vitamin C
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The role of Essential Oils (EO)

Plants produce essential oils as secondary metabolites that help protect them against predators, insects, pests and pollutants. They oil can be found in different parts of plants like roots, stems, leaves, flowers, fruits and even seeds. Essential oils are used as medicinal therapy. The practice of aromatherapy has been practiced during early civilizations due to its medicinal applications via several routes of administration (Ali *et al.*, 2015). Recently, essential oils are now receiving great attention due to their industrial uses and immune system response (Edris, 2007; Mugao *et al.*, 2020). Essential oils are volatile liquids obtained from aromatic flowers and other parts of plants. They can be produced by extraction methods such as steam distillation, low-temperature distillation, solvent extraction or hydrodistillation. The quality of the oil produced will be dependent on the method of extraction chosen. After extraction, the next process is purification and recovery of concentrated, aromatic and volatile constituents (Mugao *et al.*, 2020). The oil is usually soluble in fat and other organic solvents. The major compounds in essential oils are mono- and sesquiterpenes, phenylpropanoids and other constituents like

alcohols, esters and aldehydes (Sandner *et al.*, 2020). However, the chemical composition of essential oils may also vary among plants due to environmental factors and plant physiology (Sandner *et al.*, 2020). These components may be responsible for their antimicrobial and antioxidant activities. Several workers have researched enhanced immunomodulatory properties of essential oils (Edris, 2007; Orhan *et al.*, 2016; Peterfalvi *et al.*, 2019; Sandner *et al.*, 2020). Their works revealed that essential oils from diverse plant sources increased the number of lymphocytes, strengthened phagocytic activity, subdued inflammatory reactions and lowered cytokines by limiting the synthesis of key mediators of inflammatory pathways. Gandhi *et al.* (2019) reported increased activation of antibodies, NK cell activity to fight infections and increased T-helper cells that play major roles in the adaptive immune system, while Bhalla *et al.* (2013) revealed anti-cancer activities of essential oils.

Some Common Essential Oils and Their Roles in Immune System Response

Coconut (*Cocos nucifera* L) Essential Oil

Coconut essential oil was found to be rich in fatty acids and monoglycerides, with 80% to 90% saturated fats, and has healing and antimicrobial potential. The oil could assist in modulating the immune system and also initiate the anti-inflammatory nature of the immune response in the human body (Shashank *et al.*, 2020).

Garlic (*Allium sativum*) Essential Oil

Garlic essential oil has antimicrobial and anti-inflammatory properties. Organosulfur was the most abundant component, which may explain its antimicrobial and anti-inflammatory properties. Garlic oil can be made in two ways: liquid or solid extraction. Garlic oil was found to improve the immune response by influencing cytokine and immunoglobulin production as well as the development of macrophages, lymphocytes and natural killer cells (Arreola *et al.*, 2015).

Ginger (*Zingiber officinale*) Essential Oil

Ginger essential oil can be grouped into volatile and non-volatile constituents with the ability to treat degenerative and cardiovascular disorders, vomiting and diabetes. Ginger was reported to have antimicrobial, antioxidant and anti-inflammatory potentials that could assist in immune system response (Mashhadi *et al.*, 2013).

Lemon (*Citrus limon*) Essential oil

Lemon oil was reported to be rich in terpenes, D-limonene and L-limonene, with minute amounts of phellandrene, pinene and sesquiterpenes. These compounds were found to enhance the immune system response (Ali *et al.*, 2015).

Conclusion

Fruits, vegetables and essential oils clearly contain diverse micronutrients and bioactive substances. These nutrients and bioactive chemicals help to boost the immune system, which helps the body fight diseases, infections and foreign bodies while reducing oxidative and inflammatory stress. Increased intake of fruits and vegetables, as well as the use of essential oils, will improve immunological response.

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