

IMPACT OF ORGANIC FERTILIZERS ON NUTRITION AND HEALTH OUTCOMES

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Abstract: Organic fertilizers are derived from natural raw materials from plants and animals and contain a variety of nutrients that are essential for food production, such as potassium, phosphorus and nitrogen. These fertilizers are environmentally friendly, easy to use, and can improve soil structure, soil fertility and water retention capacity. Organic fertilizers produced using organic waste and natural materials can improve the nutritional value of crops, thereby improving human health outcomes and dietary intake. Organic fertilizers can also increase the mineral content in crops, such as the vitamin C content in tomatoes can be increased by 50% after using organic fertilizers. In addition, organic fertilizers promote symbiotic relationships between plants and microorganisms, increase microbial diversity in the soil, and improve the absorption of nutrients and water by crops. The use of organic fertilizers also helps reduce environmental pollution, promote carbon sequestration, and reduce greenhouse gas emissions. Nutrients in organic foods, such as calcium, phosphorus, magnesium and iron, are essential for maintaining human health and help prevent a variety of chronic diseases. The use of organic fertilizers reduces exposure to toxic chemicals in the food chain, thereby reducing the risk of diseases such as cancer, cardiovascular disease and type 2 diabetes.

Keywords: Organic fertilizer; Environment; Soil; Health

Organic fertilizers are produced from natural raw materials of animal or plant origin. They contain various nutrients such as potassium, phosphorus, and nitrogen which are crucial for food production. Soil organisms repeatedly break down pellets of fertilizers to release nutrients. Organic fertilizers are environmentally friendly and easy to use. In addition, these fertilizers lead to more fertile and healthier soils. Organic fertilizers improve soil structure and the ability to hold nutrients and water for a long period. They improve soil health and the availability of essential nutrients for plants. Using organic fertilizers from organic waste and naturally produced materials increases the quality of nutrients in crops, leading to better health outcomes and dietary intake for humans.

1 ORGANIC FERTILIZERS AND CROPS' NUTRITIONAL QUALITY

Using organic fertilizers increases the level of various nutrients such as antioxidants, and minerals in crops. Various vegetables such as pepper, spinach, and cabbage contain a higher level of antioxidants when organic fertilizers are used in place of chemical fertilizers. Tomatoes grown using organic fertilizers have a higher nutritional value than tomatoes grown using chemical fertilizers [1]. Using organic fertilizers improves crop germination, total yield, and vegetative growth.

Organic fertilizers increase the amount of minerals in various crops such as pepper. Sulfate, phosphate, potassium, and calcium content in pepper increases when organic fertilizers are used. The biological, chemical, and physical properties of soil increase after the application of organic fertilizers. Organic fertilizers enhance the percolation and mobilization of various minerals. In addition, they add organic matter to the soil [2]. Organic fertilizers release nutrients gradually while chemical fertilizers release nutrients quickly. Therefore, the use of organic fertilizers leads to long-term availability of nutrients in the soil.

The application of organic fertilizers promotes symbiotic relationships between microorganisms and plants. Microorganisms often decompose the organic compounds in organic fertilizers to release essential nutrients. Organic fertilizers lead to a diverse soil microbiome. They promote various microorganisms that help crops absorb nutrients and water. Organic fertilizers also enhance water retention and soil aeration [2]. This leads to good root development and easy access to nutrients. When organic fertilizers are applied to soils, they improve the ability to supply and hold more nutrients.

Organic fertilizers create a balance between various nutrients such as nitrogen, phosphorus, and potassium. They provide a balanced supply of various nutrients that support plant health. On the other hand, chemical fertilizers create nutrient imbalances by supplying higher levels of certain nutrients such as nitrogen. Organic fertilizers boost crop productivity and soil fertility. The organic carbon in organic fertilizers supports bacteria that break down nutrients. Organic fertilizers ensure that plants are not overfed. Moreover, they contribute to a sustainable environment. Chemical fertilizers cause environmental pollution as they rely on fossil fuels. Using organic fertilizers prevents environmental pollution because fossil fuels are not relied on. Using organic fertilizers benefits the environment by ensuring that nutrients are reused and not disposed of [2]. Recycling organic wastes reduces greenhouse gas emissions. It reduces methane and carbon dioxide emissions from landfills. Using organic fertilizers promotes carbon sequestration. One of the significant indicators of soil health is soil organic carbon. The benefits of soil organic carbon include

increased water retention and infiltration, higher nutrient bioavailability, and soil particle aggregation. Soil organic carbon increases the cation exchange capacity of the soil [2]. Soil organic carbon ensures that crops can easily access various nutrients such as nitrogen and phosphorus.

Cereal crops mobilize certain nutrients in the soil when organic fertilizers are applied. They increase the availability of nutrients to neighboring crops. Micronutrient content increases significantly in various crops such as cowpeas, tomatoes, soybeans, rice, and maize. "There is a 50 percent increase in Vitamin C content of tomatoes when organic fertilizers are used in place of chemical fertilizers" [2]. Zinc concentration in rice is often higher when organic inputs are used than when chemical fertilizers are used. Nutrient density in crops increases significantly when organic fertilizers are used, thereby improving nutritional quality.

Natural resources of organic fertilizers such as seaweed, manure, and compost lead to more micronutrients in organic fertilizers than synthetic fertilizers. Organic fertilizers contain more micronutrients such as manganese, copper, iron, and zinc. These micronutrients improve the quality of crops and promote plant health [1]. Organic fertilizers also contain higher amounts of other nutrients such as magnesium and calcium that support plant growth.

2 IMPACT OF NUTRITION ON HEALTH

Good nutrition is related to strong immune systems, maternal and child health, longevity, reduced non-communicable diseases, and safer pregnancy. Eating well keeps bones and teeth stronger. In addition, it slows bone loss that can occur as people get older. Calcium is a mineral that leads to the development of strong bones. Calcium is crucial for muscle function, nerve transmission, blood clotting, and hormonal secretion. The mineral helps to transmit nerve signals and form blood clots to prevent bleeding. Individuals get calcium when they eat dark green vegetables, calcium-fortified foods, green beans, nuts, broccoli, sweet potatoes, and pilchards. When individuals lack adequate calcium in the body, they are likely to develop various bone issues such as decreased bone density, fractures, and osteoporosis.

Good nutrition enables people to maintain a healthy weight. A balanced diet provides proportions of micronutrients such as minerals and vitamins and macronutrients such as fats, proteins, and carbohydrates. It consists of various foods such as whole grains, fruits, vegetables, lean proteins, and healthy fats. A balanced diet provides the right proportions of various nutrients that support bodily functions and promote vitality. Proper nutrition is linked with a healthier, longer life. Nutrient-rich diets reduce the risk of various age-related diseases such as diabetes and cancers.

Potassium and calcium intake reduce the risk of stroke, regulate blood pressure, and prevent tubular, glomerular, and vascular damage. Potassium relaxes the walls of blood vessels. In addition, it lowers the risk of developing arrhythmias and regulates heartbeat. Potassium also lowers the risk of developing kidney stones. It prevents weakness and muscle cramps. Potassium transmits nerve signals that affect reflexes and muscle movements. Potassium intake improves glucose metabolism and insulin sensitivity. Therefore, it lowers the risk of Type II diabetes. Growing various foods organically such as spinach, sweet potatoes, and beans ensures that they get adequate amounts of potassium. This element regulates blood pressure and prevents vascular damage.

Taking foods rich in phosphorus promotes bone health, energy production, cell function, and acid-base balance. Phosphorus works with calcium to improve bone strength and maintain structure. Moreover, phosphorus plays an essential role in adenosine triphosphate formation. Phosphorus supports cell function and structure through phospholipids. The higher levels of phosphorus found in organic fertilizers have a positive impact on human health. Foods rich in phosphorus include certain vegetables, legumes, whole grains, seeds, and nuts.

Sulfates promote joint health, skin health, digestive health, and detoxification. They detoxify the liver and alleviate osteoarthritis symptoms. Sulfates help in the synthesis of digestive enzymes. In addition, they regulate gut bacteria and promote skin healing and health. Sulfates reduce inflammation and help maintain the proper functioning of blood vessels. The anti-inflammatory effects of sulfates improve respiratory function and reduce asthma symptoms.

Nutrition affects immune function and digestive health. Vitamins A, C, and E support immune function by enhancing the skin barrier. Vitamin A plays various roles in the human body such as vision, immunity, cell development, skin health, and reproductive health. Vitamin A plays a crucial role in rhodopsin formation. This protein enables individuals to have good eye health. Vitamin A boosts the immune system by helping in the production of white blood cells. It plays an essential role in cell development. Vitamin A is crucial for fetal development and reproductive health during pregnancy.

Vitamin E supports immunity, skin health, cellular function, and heart health. Vitamin E prevents cardiovascular diseases because it inhibits cholesterol oxidation. Furthermore, Vitamin E supports immunity as it improves the immune response of the body. Vitamin E also promotes skin health by maintaining elasticity and moisture. Vegetable oils, nuts, seeds, fruits, and fortified foods contain Vitamin E. Vitamin E deficiency causes vision issues, immune dysfunction, and neuromuscular problems. Taking foods with adequate amounts of Vitamin E prevents chronic diseases.

Vitamin C is found in green peppers, potatoes, tomatoes, and citrus fruits. It plays a crucial role in adaptive and innate immunity. Vitamin C decreases histamine levels, normalizes cytokine production, and enhances phagocytosis. The antioxidant action of Vitamin C lowers oxidative stress when one has infections. Vitamin plays a crucial role in wound healing, iron absorption, and collagen synthesis. Collagen supports bones, cartilage, blood vessels, and the skin. Vitamin C deficiency causes joint pain, bleeding gums, and fatigue. Adequate intake of vitamin C lowers the risk of certain cancers and heart disease.

The high concentration of magnesium and iron in organic fertilizers promotes human health. Magnesium promotes muscle function, bone health, energy production, cardiovascular health, and nerve function. Magnesium is involved in

the formation of bones and the contraction of muscles. This mineral prevents spasms and muscle cramps by regulating the level of calcium in cells. Magnesium is also important in the production of adenosine triphosphate. Magnesium regulates blood sugar by playing an important role in glucose metabolism and insulin sensitivity. Sources of magnesium include green vegetables, legumes, fish, fruits, and whole grains.

Iron is required for various biological functions such as cellular respiration and oxygen transport. Iron transports oxygen as it is part of hemoglobin. In addition, iron is essential in metabolic processes. Adequate amounts of iron in the body help in the maturation and proliferation of immune cells. Iron also plays a crucial role in cognitive function. Iron deficiency causes fatigue, neurocognitive defects, and immune defects. Iron deprivation also causes irreversible changes in the intestinal microbiome [3]. There is a significant association between the incidence of coronary heart disease and iron intake. The amount of iron intake is inversely proportional to the incidence of coronary heart disease.

Various minerals such as zinc support immune function. Zinc plays a crucial role in the functioning and development of immune cells such as phagocytes and T-lymphocytes. The severity and duration of illnesses reduce when there are adequate levels of zinc in the body. Zinc also helps maintain the structure and integrity of the skin. It is used in the production of DNA and proteins. Zinc regulates various hormones such as insulin that control blood sugar. Individuals obtain zinc from various sources such as whole grains, nuts, seeds, lentils, fortified cereals, and beans. Zinc deficiency can create skin issues such as dermatitis and skin lesions [4]. It can also cause weak immunity and high susceptibility to diseases. Zinc plays an important role in cell division, cell differentiation, cell growth, transcription, and cellular transport.

Taking organic foods significantly reduces the risk of various diseases such as cancer, cardiovascular disease, and type II diabetes. Organic fertilizers are used to produce organic foods. These fertilizers include plant-based materials, bone meal, manure, and compost. The antioxidants and polyphenolics in organic fertilizers are linked to a lower risk of chronic diseases. Using organic fertilizers ensures plants do not absorb toxic chemicals. On the other hand, using chemical fertilizers increases the risk of toxic chemicals entering the food chain. Uranium, cadmium, lead, and mercury have been found in chemical fertilizers. These heavy metals enter the food chain after being absorbed by cereals and vegetables [4]. They often cause cancer, and liver, lung, and kidney disturbances. Using organic fertilizers limits exposure to heavy metals that affect body organs adversely.

According to [3], a significant number of chemical fertilizers have tested positive for various heavy metals such as vanadium, thallium, selenium, nickel, and silver. Heavy metals often affect brain development negatively. Chemical fertilizers cause high concentrations of various compounds such as organophosphate metabolites in children. These compounds adversely affect brain growth and development. In addition, they increase the likelihood of developing attention deficit hyperactivity disorder (ADHD). Children with high levels of pyrethroids are likely to develop ADHD and behavioral issues [3]. Organic farming reduces the likelihood of children developing behavioral issues and mental disorders because it limits the use of harmful chemicals.

Nutritional deficiency is linked with anxiety disorders. Lack of Vitamin B6 and B12 causes mood disorders such as anxiety. Vitamin B6 and B12 are involved in the production of dopamine and serotonin. Adequate levels of dopamine and serotonin are not produced when one lacks Vitamins B6 and B12. Anxiety disorders are also associated with low levels of magnesium and zinc in the body [4]. Magnesium regulates stress response while zinc plays a crucial role in neurotransmitter regulation.

There is a significant correlation between dietary intake and other diseases such as asthma. Diets rich in Vitamin E and Vitamin C improve asthma symptoms. Eating foods that do not have antioxidants causes oxidative stress and inflammation in the lungs and worsens asthma symptoms. In addition, vitamin D deficiency causes asthma severity [4]. Maintaining a well-balanced diet is associated with better lung function and management of asthma symptoms.

Sleep disorders have a significant relationship with nutritional quality. Balancing fats, proteins, and carbohydrates influences sleep. Complex carbohydrates increase tryptophan availability, a compound that encourages sleep. Tryptophan can be found in various foods such as seeds and nuts. This compound boosts melatonin and serotonin production [3]. Vitamin D deficiency has been linked to sleep disorders. Intake of adequate vitamin D levels can boost sleep quality.

Intake of low-nutrient and high-calorie foods is linked with obesity. Obesity increases the risk of various diseases such as cancer, coronary heart disease, and type II diabetes mellitus. Obesity occurs when there is a reduction in energy expenditure and an increase in energy intake. "The National Health and Nutrition Examination Survey (NHANES) observed that the average daily energy intake increased by 168 kcal/day in men and 335 kcal/day in women" [2]. Whereas energy intake has increased significantly, energy expenditure has decreased. There has been a substantial increase in weight among American adults due to the consumption of high-calorie foods and lack of exercise. Plant-based foods such as fruits and vegetables are recommended instead of meat. Access to healthy food options is; however, limited among low-income communities.

Gastrointestinal disorders are associated with low nutritional quality of foods. These disorders include lactose intolerance, irritable bowel syndrome, and gastroesophageal reflux disease. Gastrointestinal disorders cause nausea, pain, vomiting, heartburn, diarrhea, constipation, and bloating. Digestive issues occur when individuals consume diets that lack diverse nutrients. Chronic constipation has been associated with a lack of fruits and vegetables in the diet. A strong correlation between eating habits, disease activity, and symptomatology has been observed [4]. The microbiota of individuals whose diets are rich in fiber and plant derivatives are different from individuals whose diets are rich in proteins, fats, and carbohydrates.

Multiple sclerosis is linked with the consumption of meat, animal fats, and milk, as well as obesity and high energy intake. On the other hand, diets containing plant fiber and polyunsaturated fatty acids lower the risk of multiple sclerosis. Individuals with multiple sclerosis are likely to have deficiencies in various nutrients such as Vitamin A and Vitamin B12 [5]. The symptoms of multiple sclerosis are improved by plant compounds, melatonin, antioxidants, fatty acids, minerals, and certain vitamins.

Environmental exposure to heavy metals such as cadmium occurs through drinking water, inhalation, and food ingestion. The primary route of cadmium exposure is dietary intake. A significant amount of cadmium and other heavy metals accumulate in the kidneys. Exposure to cadmium during pregnancy has caused developmental delays and low birth weight among children. It has affected fetal development adversely and caused proteinuria. Cadmium accumulates in the placenta, causing various effects such as reduced synthesis of placental hormones, altered cell migration and cell integrity, and reduced blood flow to the placenta. In addition, cadmium interferes with the transportation of micronutrients from the mother to the embryo or fetus [5]. Chronic exposure to cadmium has led to kidney damage, bone health issues, and cardiovascular disease. Good nutrition limits the intake of heavy metals that have adverse impacts on human health.

Organic foods often contain higher levels of omega-3 fatty acids than conventional foods. Omega-3 fatty acids lower blood pressure and improve cardiovascular health. In addition, they reduce the risk of arrhythmia, blood clots, breast cancer, and Alzheimer's disease. Omega-3 fatty acids are crucial for brain health, eye health, metabolic health, and reduction of inflammation. These fatty acids are crucial for cognitive development and function[5]. Their anti-inflammatory properties reduce inflammation and help in conditions such as inflammatory bowel disease, asthma, and arthritis. Deficiencies in omega-3 fatty acids cause impairments in cognitive function.

Growing foods using organic fertilizers reduces health issues caused by pesticide exposure. When organic fertilizers are used, residues of synthetic pesticides in crops are reduced significantly. Organic farming relies on biological and agricultural means of protecting plants. These include intercropping, crop rotation, hygiene practices, and biological control using natural enemies. Organic fertilizers rarely contain synthetic pesticides. Therefore, they ensure that consumers are not exposed to chemical substances with carcinogenic, endocrine-disrupting, and neurotoxic properties [3]. Using organic fertilizers reduces the risk of leukemia, lymphomas, and Parkinson's disease. It promotes mental and psychomotor development in children.

Using organic fertilizers eliminates the risk of exposure to harmful chemicals found in chemical fertilizers. Chemical fertilizers contain compounds such as ammonium nitrate that cause skin and eye irritation. Exposure to ammonium nitrate causes sore throat, skin redness, itching, shortness of breath, coughing, weakness, depression, and headache [3]. Ammonium nitrate explosions in manufacturing plants have caused injuries to many people.

Crops grown using organic fertilizers have a higher nutritional value than crops grown using chemical fertilizers. Sulfate, phosphate, potassium, and calcium content in various crops increases when organic fertilizers are used. Using organic fertilizers increases the level of various nutrients such as antioxidants, and minerals in crops. Moreover, it reduces exposure to harmful chemicals and heavy metals. The higher nutritional quality of crops grown using organic fertilizers has a positive impact on human health. High nutritional quality is associated with a lower incidence of various diseases such as obesity, cancer, diabetes, cardiovascular diseases, hypertension, osteoporosis, anemia, mental health disorders, and gastrointestinal disorders.

COMPETING INTERESTS

The authors have no relevant financial or non-financial interests to disclose.

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