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Comparing Organic and Conventional Foods: Nutritional Value, Farming Practices, and Health Impacts

Yang Ning[1,*]

[1]Department of Chemistry, University at Buffalo, Buffalo, NY, 14228, USA
[*]Corresponding author: yangning@buffalo.edu

Abstract:

Recently, people's choices have been influenced by growing concerns about health and the environment. Current research suggests that organic foods may have health benefits. The reason for this is that organic foods do not contain pesticides and have higher nutritional content and bioactive compounds. Furthermore, organic farming reduces greenhouse gas emissions and promotes biodiversity. Animal welfare is also taken into account in animal farming practices. However, research is still needed to understand the long-term health impacts of agriculture, as well as to address challenges related to productivity. This review aims to compare conventional and organic foods in terms of nutrition, farming practices, animal husbandry, and health impacts. While organic foods are often labeled as good for the environment, conventional methods are sometimes superior in terms of yield and nutrition. A mix of both methods is essential to creating sustainable systems. In the future, research should focus on the impacts of agriculture on human health and explore innovative methods for improving productivity in order to meet the needs of the global food supply.

Keywords: Organic food; conventional food; health benefit; disease.

1. Introduction

Healthy living and environmental sustainability are present and have become at the top of people's minds. The purchases of organic foods are rising fast. The organic food market will increase to reach $231.5 billion in 2023, with an expected growth of 13.9 % between 2024 and 2030 [1]. Most people believe that organic food is healthier than conventional food [2]. Are organic foods healthier than conventional food? There are studies demonstrating that organic food consumption reduces toxic chemical residues and increases the levels of nutrients and bioactive compounds [3]. In comparison to conventional foods, organic foods have lower concentrations of pesticides, cadmium, and higher levels of bioactive compounds, such as polyphenols, whereas organic animal products often have higher contents of good

fats, such as omega-3 polyunsaturated fatty acid [3]. All of these are necessary to prevent disease and keep healthy. Organic agriculture also has implications for the wider environment and public health. By reducing the use of chemicals and reducing the environmental impact, many people define organic farming as more sustainable than conventional farming [4]. From the point of view of antimicrobial resistance, the prevalence of antibiotic-resistant microorganisms in farm animals will decrease as organic agriculture restricts the use of antibiotics [5]. In addition, studies have shown that eating organic food over a long period of time can lead to more positive personality traits [6].

The aim of this review is to evaluate whether conventional and organic foods differ in terms of their content of bioactive compounds and contaminants, health-promoting effects, and nutritional value. The available scientific literature will be reviewed to provide a multi-faceted representation to consumers regarding food choice, as well as support the establishment of public health policies.

2. Applications of Organic Food

2.1 Agricultural Production

Organic and conventional agriculture differ in farming practices, environmental impact, and pest control. Conventional agriculture employs high-yield crop rotations with the objective of maximizing short-term crop yield [7]. Chemical fertilizers, pesticides, and herbicides are lavishly applied to help achieve this goal [7]. Although long-term plant growth conditions and crop yield might be enhanced, synthetic products are applied to fields in an indiscriminate manner, often with grave long-term consequences. Chemical fertilizers, for example, when applied in huge amounts, lead to soil erosion, loss of biodiversity, and agrochemical pollution of water supplies [8]. Recent studies suggest that the intensive chemical management and the use of broad-spectrum insecticides in conventional agriculture could contribute to a reduction in biocontrol agents, and therefore disrupt and weaken crop resilience by suppressing their natural defenses [9]. Fast-acting synthetic fertilizers often induce a nutrient imbalance and cause stress in plants as well, leading to their susceptibility to pests and diseases [9]. Compared to conventional agriculture, organic agriculture demonstrates concern for sustainable farming practices that could support soil health, higher biodiversity, and reduce the polluting impact on the surrounding environment. Organic agriculture uses natural strategies for maintaining soil fertility in place of synthetic fertilizers and pesticides. Organic systems use complex plant rotations, cultivations of soil with compost to recycle nutrients naturally, and biological control to suppress weeds and control pests [7]. In organic systems, compost, cover crops, and animal manure release nitrogen and other nutrients slowly and promote a healthy soil microbial community [9]. Therefore, plant defense genes are expressed more effectively, pest and disease resistance increases, and plant health improves [9]. Organic agriculture also uses natural pesticides that are highly effective and with less or no environmental distortion. The essential oil of Zanthoxylum limonella has also been shown to have strong larvicidal activity against Aedes aegypti and Aedes albopictus mosquitoes, with both LC50 values of 2.5–3.7%; larval mortality was complete within 24 hours [10]. In comparison with the persistence of synthetic pesticides, most Zanthoxylum products degrade and return to the ecosystem quickly [10]. Therefore, Zanthoxylum products are considered to be highly suitable for alternative tool design in a sustainable pest management toolbox [10]. A major drawback of organic agriculture is that it generally produces lower yields, between 20 and 50 percent lower yields compared with conventional agriculture, depending on the crop and region [8]. This is a dire threat to world food supply [8]. Lower productions require more land to produce the same amounts of food, which may result in deforestation and biodiversity loss. However, organic agriculture also has a wide range of benefits in environmental protection, such as reducing the emission of greenhouse gases and increasing soil carbon sequestration [11,12]. Besides, another remarkable feature of organic systems is their high resilience to environmental stresses [8]. This is because the soil of natural or organic systems is highly diverse and displays a rich biotic community, unlike the simplistic taxonomic diversity of the soil of conventional agriculture [8].

While organic agriculture has lower productivity and requires more land than conventional agriculture to produce equivalent food output, it benefits the environment and human health when contemplating global climate change and environmental degradation. Researchers striving to develop more resilient agricultural systems that benefit both the environment and human health require a paradigm that integrates organic and conventional agriculture.

2.2 Animal Husbandry

Animal welfare and environmental impact are different between organic and conventional animal husbandry. One benefit of organic animal husbandry is that it gives animals more natural living conditions like outdoor activities and natural light and provides organic feed for animals as well [13]. Antibiotics and growth hormones are also avoided [13]. These methods mimic natural behavior and improve livestock‘s overall health and stress levels [13].

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Organic animal husbandry allows livestock and agriculture to work together to make a sustainable ecosystem [13]. Recycling livestock manure creates a nutrient cycle and reduces the need for synthetic fertilizers [13]. In contrast, conventional animal husbandry involves the confinement of animals in small spaces such as cages or sheds [14]. With the growth, intensive farming has emerged [14]. However, increasing scale has led to a series of problems. Due to the increased amount of animal manure, it is difficult to dispose of it [14]. Farmers discharge animal manure into rivers, which pollute water sources and destroy biodiversity [14]. Additionally, indoor farming releases greenhouse gases such as carbon dioxide and methane, contributing to global warming [14]. There is also an increase in acid rain and biodiversity acidification due to 64% ammonia emissions [14]. Further, high-density farming practices may increase productivity, but they can also increase animal disease susceptibility [14]. Research shows zoonotic diseases have spread to 2.4 billion people in low- and middle-income countries [14]. As a result, antimicrobial drugs have been used more frequently, leading to an increase in antimicrobial resistance [15]. When antibiotics and other antimicrobial drugs fail, it is difficult to cure diseases caused by infections [16]. The World Health Organization reported 1.27 million deaths caused by antimicrobial resistance in 2019 [16].

The findings of these studies suggest that organic animal husbandry offers a sustainable approach that balances the needs of consumers for superior products with the protection of the environment and the welfare of animals. However, conventional animal husbandry, in its pursuit of efficiency, decreases animal welfare and increases antimicrobial resistance. This poses a risk to public health.

2.3 Nutritive Value

Organic foods tend to have higher nutritional value than conventional foods in several key ways. According to research, organic yogurt and kefir contain higher levels of lactic acid bacteria (LAB) than conventional yogurt and kefir [17]. There were 75.6 x \[{10}^{7}\] CFU/g in organic yogurt compared to only 0.033 x \[{10}^{7}\] CFU/g in conventional yogurt [17]. Similarly, organic fermented carrot juice had a higher LAB content of 2.00 × \[{10}^{4}\] CFU/mL than conventional fermented carrot juice of 1.00 × \[{10}^{4}\] CFU/mL [17]. However, conventional pickled beet juice and pickled cucumbers had higher LAB content than the organic versions [17]. The calcium content of organic kefir was also higher at 165.75 mg/100 g than that of conventional kefir at 153.80 mg/100 g [17]. However, there was no significant difference in the calcium content between organic and conventional kefir and buttermilk [17]. Moreover, organic vegetables, such as sauerkraut and kimchi, contain a higher level of vitamin C than conventional vegetables [17]. The amount of vitamin C contained in organic sauerkraut is 5.3678 mg per 100 grams, compared to 3.5538 mg in conventional sauerkraut [17]. The vitamins in organic tomatoes are 6% higher than those in conventional tomatoes [18]. However, there was no significant difference in vitamin C between juices made by organic and conventional methods [17]. In terms of β-carotene content, organic and conventional carrot juices had similar concentrations, but the β-carotene content of 1.0656 mg/100 ml in conventionally fermented beet juice was higher than that of 0.2407 mg/100 ml in organic carrot juice [17]. In general, organic crops contain higher levels of polyphenols and antioxidants [18]. Research has shown that organic spinach contains 40.48 mg/kg of flavonoids, which is higher than conventionally grown spinach which contains 25.75 mg/kg [18]. Furthermore, organic tomatoes contain 79% more quercetin and 97% more kaempferol than conventional tomatoes [18]. Organic animal products, such as beef and milk, are typically higher in omega-3 polyunsaturated fatty acids [19]. The amount of Omega-3 fatty acids in organic milk is 0.05 g higher per 100 grams compared to standard milk [19]. However, the difference is too small to prove that it makes a significant difference in the human body [18]. In general, conventional products contain more nitrogen than organic products due to the use of synthetic fertilizers, and the amount of nitrogen can have a negative impact on the nutritional balance of food [19]. However, some research shows that organic produce could have higher levels of mycotoxins due to lack of fungicides [19]. Organic foods are more nutrient-rich than conventional foods in general. Examples are lactic acid bacteria, vitamin C, polyphenols, and antioxidants. However, it is feasible that selected conventional foods might be richer in β-carotene and lactobacilli than appropriate organic foods and organic foods might have higher levels of mycotoxins.

3. The Mechanism of Action of Organic food on human health

3.1 Effects on the Human Body

With the increase in organic production, the health advantages of foods produced this way have become the focus of studies as well, which suggest that organic foods have numerous positive health benefits. The impact of organic foods on obesity and body mass index (BMI) is a crucial aspect, where the incidence of organic food consumers with lower BMI and a 37% lower occurrence of obesity in comparison to those that do not consume organic food

has been widely studied. [20]. However, the correlation between organic food consumption and lower BMI may be attributed to organic food consumers‘ dietary patterns [20]. In general, people who eat organic food maintain a healthier diet and lifestyle [20]. Therefore, there is limited evidence to support the relationship between organic food consumption and body mass index and should be confirmed by long-term and controlled studies [20]. The consumption of organic food has also been associated with a reduced risk of developing certain chronic diseases. Research shows people who consume organic foods have a 21% lower risk of getting non-Hodgkin‘s lymphoma [21]. There is also a lower risk of breast cancer in women who consume organic foods [21]. Besides, for every 5% increase in the organic foods in the diet, the risk of developing type 2 diabetes was reduced by 3% [22]. Compared with conventional agriculture, organic agriculture produces lower levels of pesticide exposure, resulting in fewer cases of gastric, colorectal, liver, bladder, and brain cancer [20]. These preeminent benefits show that organic food may reduce the incidence of serious diseases and improve human health. Furthermore, the consumption of organic food may improve reproduction. Research shows that men who eat organic food are less likely to get genital diseases [23] and have more sperm concentrations [19]. Organic food may potentially improve male fertility. Women who consumed organic products during pregnancy had a 21% reduced risk of developing pre-eclampsia [24] which involves high blood pressure and the risk of permanent organ damage [18]. All the reproductive benefits strengthen the potential high benefits of organic food in humans. The benefits on human offspring should not be overlooked. Since the level of detoxification enzyme activities in children is lower than those in adults, children may be relatively more sensitive to pesticide toxicity [20]. Compared to children on regular food, children on organic diets had fewer pesticide residues in their urine [25]. These results indicated a 95.5% reduction in Malathion residue, 41.9% reduction in Chlorpyrifos residue, 77.2% reduction in Clothianidin residue, 4.4% reduction in Pyrethroid Metabolites, and 32.4% reduction in 2,4-D residue in urine [25]. By reducing the levels of pesticides in the body, children are less likely to be exposed to toxic substances, which reduces the risk of developmental delays, hormonal disorders, as well as increased cancer incidence among children [25].

3.2 Effects on Mental Health

The consumption of organic food is not only beneficial for physical health but also positively affects mental health. Research has shown that organic crops are higher in antioxidants than conventional crops [26], and depression is associated with low antioxidant intake [27]. Therefore, eating organic foods may alleviate depression symptoms. It has been found that people who consume organic foods regularly generally demonstrate more positive personality traits, such as honesty, agreeableness, and conscientiousness [6]. Consumption of organic food is also associated with increased subjective well-being, particularly in the areas of physical, emotional, social, and intellectual well-being [23]. As a result of the survey, people were assigned a 7-point agreement scale with a score of 6 for organic food making them feel healthier and a score of 5 for making them feel positive emotions [23]. Based on the results of this survey, it is evident that consumers believe that organic food contributes to their overall health and emotional well-being [23]. Consumers usually feel satisfied, happy, and responsible when choosing organic food, which contributes to their emotional well-being [23]. A social perspective indicates that the consumption of organic foods is also associated with the enhancement of self-image and the strengthening of relationships with others due to its congruence with the values of environmental awareness and ethical behavior [23].

4. Conclusion

This review summarizes the differences between organic and conventional foods in terms of nutrient content, agricultural practices, animal husbandry, and effects on human health. It is mentioned in the text that organic foods usually contain lower levels of pesticide residues and cadmium, and have higher levels of polyphenolic compounds, vitamin C, and antioxidants. Additionally, organic animal products are higher in Omega-3 polyunsaturated fatty acids. Due to reduced chemical inputs, organic agriculture has environmental benefits, including reduced greenhouse gas emissions and increased biodiversity. In terms of yields and certain nutrients, organic agriculture is less productive than conventional agriculture and determining ways to increase its productivity remains a challenge.

In addition, the review analyzes the potential health benefits of organic foods. It reduces the risk of chronic diseases, obesity, and specific cancers, and improves reproductive health and child development. It shows the progress of organic food benefits public health and the environment.

However, this review does not examine the specific impact of organic agriculture on global food security, particularly the practical feasibility of expanding organic agriculture on a large scale. Moreover, there is a lack of empirical evidence regarding the effects of long-term consumption of organic foods on human health, such as mycotoxin residues.

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The focus of future research should be on the long-term health effects of organic agriculture, particularly the sustainability issue after large-scale promotion. Additionally, innovative solutions relating to how organic agriculture can improve its productivity and contribute to global food security should be developed to meet future global needs.

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