Organic Fresh Produce

Subjects: Nursing

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Growing and purchasing demand for organic fresh produce is increasing rapidly. Consumers are aware of health, environmental safety, pesticide harmfulness, nutrients, bioactive compounds, and safe food. Many research works are available on organic and conventional fresh produce. As organic fresh produce growing and purchasing demand is increasing, it has become necessary to review the recent trends in quality, safety, and consumer preferences of organic and conventional fresh food products. A few reports have been compiled on organic and conventional fresh produce. Researchers have started working on organic and conventional fresh produce with the help of modern technology to improve nutritional and functional quality, safety, and consumer preferences. Nutritional and functional quality, safety, and consumer preferences depend on cultivation techniques, treatment, crop cultivar, and appearance of products. Therefore, it is necessary to compile the literature on organic and conventional fresh produce based on quality, safety, and consumer preferences.

antioxidant phenolic content sugar content vitamin C

1. Introduction

Organic and conventional fruit, vegetable, and cereal quality, safety, and preferences are becoming an issue for producers and consumers considered in the literature. Consumers demand quality and safety of fresh produce. Fresh produce quality reflects on taste, color, nutritional value, and microbial safety [1][2].

As it is grown in an organic manner, there undoubtedly are no synthetic pesticides and fertilizers, which can be harmful to human health. While synthetic pesticides are not authorized in many countries for organic farming, growers use manure and compost as organic fertilizer [3][4]. Growing and consumption trends are increasing daily. For example, there has been around 90% sales increase in North America and Europe [5]. The organic food industry is convincing the public that it is healthier, tastier, and better for the environment. Consumers prefer organic produce due to socioeconomics and attitudes to human health and the environment.

The conventional system typically uses synthetic pesticides and fertilizers, which can be harmful to human health if growers use them improperly [4][6]. For the careful application of synthetic pesticides and fertilizers, growers need proper knowledge about plant nutrients and food safety. Adequate application of fertilizers, pesticides, and manure can be beneficial for human health.

It is very difficult to compare organic and conventional foods. A valid comparison requires the same cultivar, proximity of the farms, similar growing media, same climate conditions, and a similar growing system. In this review paper, we tried to compare organic and conventional fresh produce according to quality, safety, and consumer preferences. Moreover, we focused on fresh produce growing materials in the organic and conventional systems. This article highlighted an overview of the recent works on organic and conventional fruit, vegetable, and cereal production systems, product quality, product safety, and consumer preferences.

2. Consumer Perception of Fresh Produce

Organic fresh produce markets are the fastest-growing in agriculture. In the year 2018, the organic food revenue in the USA was 40.56 billion euros, followed by Germany (10.91 billion euros) and France (9.14 billion euros), China (8.09 billion euros), Italy (3.48 billion euros), Canada (3.12 billion euros), Switzerland (2.66 billion euros), UK (2.54 billion euros), Sweden (2.30 billion euros) and Spain (1.90 billion euros) [7]. The growing and purchasing trends may vary from one country to another because of consumer demand. The per capita consumption of organic food in 2018 was the highest in both Denmark and Switzerland (312 euros), followed by Sweden (231 euros), Luxemburg (221 euros), Austria (205 euros), France (136 euros), Germany (132 euros), and the USA (124 euros) [7]. Consumers agreed to pay more for pesticide-free fresh produce because of perceptions of the negative health impact of synthetic pesticides [8]. Paying more for organic produce mainly depends on higher income, and the negative impact—on pesticides [8].

Safe consumption depends on personal and economic factors, sociocultural factors, and marketing factors [9]. These are age, gender, education, and marital status (personal factors); income and purchase intentions (economic factors); family size, status, and composition (sociocultural factors); price, advertising, and place (marketing factors). Besides, organic food consumption is influenced by the 4 P's: product, price, place, and promotion.

Fresh and sustainable consumption, extrinsic attributes, health, sensory appeal, weight concern, and social status are used to consider organic food products. Furthermore, consumer motives, preferences, and attitudes can vary depending on the product category. Consumers are willing to pay additional 0.18 euro/kg organic apples in Italy [10], whereas in Denmark, it is 0.72 euro/kg [11]. Marketing strategy, product competition, social status, product satisfaction, and income may influence product purchases. Consumers like to buy organic vegetables at a higher price [12] because of safety. They also mentioned that purchasing organic food depends on attitudes, experiences, health status, knowledge, income, price, and sales. Organic food price is 10–40% higher in Denmark than the conventional food price [13] and 50–100% higher in Romania [14] due to consumers' demand and high production cost. Organic fruits are safer because there are no pesticide residues. Appearance, freshness, nutritive value, and taste determine organic food preferences of consumers. Consumers prefer organic food due to its healthfulness and less environmental impact [15]. As a result, there is an increasing trend to consume organic foods instead of conventional foods.

3. Organic and Conventional Methods of Growing Fresh Produce

Organic fresh produce demand is increasing [7]. We need to confirm that organic fresh produce is rich in nutritional quality for human health. The improved nutritional value mainly depends on the cultural system, treatment, growing position, and environment. In the past two decades, many different research works have been compiled on organic and conventional systems [3][4][16][17][18][19][20]. According to Reganold and Wachter, [47] conventional cultivation showed higher yield and higher total cost. The impact of organic and conventional methods on the quality of fresh produce is presented in Figure 1.

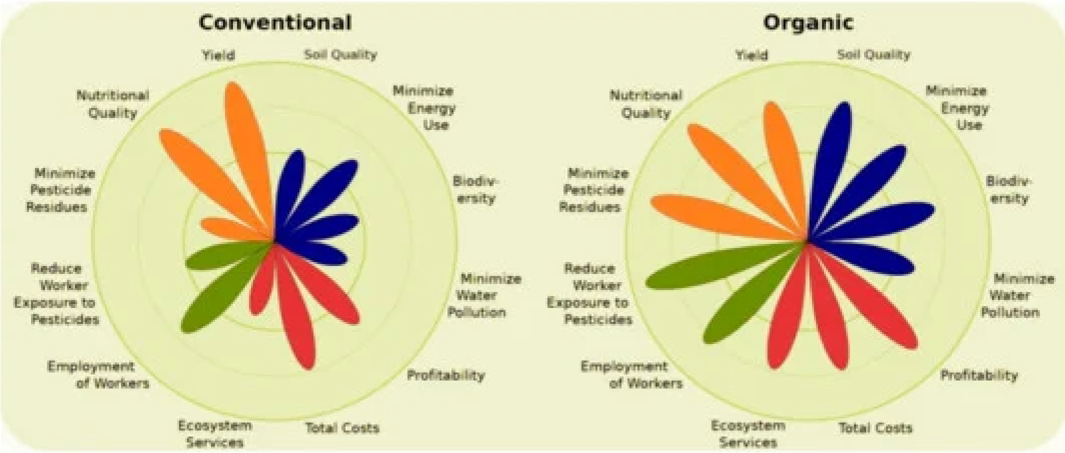

Figure 1. Difference between conventional and organic farming [21].

The quality of fresh produce grown using organic and conventional methods is shown in Table 1. Among blueberries, the content of fructose, glucose, citric acid, malic acid, anthocyanin, total phenols, and flavonoids was higher in the organic ones than in the conventional produce [17]. Jin et al. [18] reported that organically grown strawberries contained higher glutathione, ascorbic acid, total anthocyanin, total phenolic acids, and had higher antioxidant activity compared to the conventionally grown ones. Organic tomatoes contained high sugar, phenols, flavonoids, whereas the conventionally grown ones had high acidity and high content of total polyphenols [16]. Organic bell peppers showed high dry matter, vitamin C, total carotenoids, total phenolic acids, quercetin, and kaempferol and conventional bell peppers showed high antheraxanthin, lutein, total flavonoids, myricetin, and luteolin [19]. In organic beetroots, dry matter, sugar, and vitamin C were increased [3], while antioxidant activity and ascorbic acid content were increased in lettuce [4]. Conventional beetroots showed high total polyphenols, flavonoids, and quercetin [3], while conventional lettuce showed high total soluble solids content, titratable acidity, total phenolic and total chlorophyll content [4]. Therefore, quality variation depends on the treatment, crops, and cultivation practice, but it is not possible to assign positive effects only to organic farming [3][4][16][17][18][19].

Table 1. The impact of organic and conventional methods on the quality of fresh produce.

No.	Cultural Methods	Fresh Produce	Treatment	Quality	References
1	Organic and conventional	Blueberries	Organic: cover crops, peat, compost, fish meal, humus, and manure and organic	Organic: fructose, glucose, citric acid, malic acid, anthocyanin, total phenolic	[17]

No.	Cultural Methods	Fresh Produce	Treatment	Quality	References
			herbicides (crop oils, vinegar, and soaps) Conventional: NPK fertilizers, pesticides, herbicides, insecticides, and fungicides	acids, and flavonoids are high. Conventional: fructose, glucose, citric acid, malic acid, anthocyanin, total phenolic acids, and flavonoids are low.	
2	Organic and conventional	Strawberries	Organic: horse manure, granite dust, no herbicides or insecticides, NPK from steamed bone meal, feather meal, soybean meal, langbeinite, and compost. Conventional: NPK fertilizers, fungicides Switch and Captec, insecticides Lorsban and Brigade, herbicides Stinge and Herbimax.	Organic: glutathione, ascorbic acid, total anthocyanin, total phenolic acids, and antioxidant activity are high. Conventional: glutathione, ascorbic acid, total anthocyanins, total phenolic acids, and antioxidant activity are low.	[18]
3	Organic and conventional	Tomatoes	Organic: green manure, 60% compost; biohumus, cow manure Conventional: NPKMgS fertilizers	Organic: sugar, phenol, flavonoids are high. Conventional: acidity and total polyphenols are high.	[16]
4	Organic and conventional	Bell peppers	Organic: green manure, compost, cow manure, organic protection. Conventional: NPKS fertilizers, synthetic protection.	Organic: dry matter, vitamin C, total carotenoids, total phenolic acids, quercetin, and kaempferol are high. Conventional: antheraxanthin, lutein, total flavonoids, myricetin, and luteolin are high.	[19]
5	Organic and conventional	Beetroots	Organic: N (low and high) from compost and manure, no pesticides. Conventional: N (low) with pesticides.	Organic: dry matter, sugar, and vitamin C are high. Conventional: total polyphenols, flavonoids, and quercetin are high.	[3]
6	Organic and conventional	Lettuce	Organic: Altavita, Altaverde, cow and chicken manure, no pesticides. Conventional: NPK with deep irrigation.	Organic: antioxidant activity and ascorbic acid content are high. Conventional: total soluble solids content, titratable acidity, total phenolic content, and total	[4]

References

No.	Cultural Methods	Fresh Produce	Treatment	Quality	References
				chlorophyll content are high.	

Note: No. 6 refers to the greenhouse soil and the rest of them refer to field soil.

4. Nutritional Quality of Fresh Produce

In this section, soluble solids, sugar content, dry matter content, and dietary fiber are discussed. Increase and decrease in nutritional quality may depend on growing conditions and environmental factors.

4.1. Soluble Solids Content

The soluble solids content is an important parameter for consumer preferences. A higher soluble solids content is often associated with better taste [20]. This parameter is determined by measuring the amount of soluble sugar. In organic apples and strawberries (Diamante and San Juan), the soluble solids content increased [22][23] (Table 2). In the conventional cultivation system, the soluble solids content also increased in strawberries (Lanai), tomatoes, beets, and lettuce [3][4][6][24][22][23]. Some discovered that organic tomatoes, oranges, kiwifruits, lemons, and mandarins are rich in soluble solids [25][26]. Benge et al. [27] mentioned that conventional kiwifruits showed higher soluble solids than the organic ones, resulting in maturity. They mentioned that organic kiwifruits were probably harvested less mature. The increase and decrease in the soluble solids content may be influenced by cultivar, cultivation practices, treatment, nutritional concentration, and maturity stages of harvesting fresh produce.

Table 2. Soluble solids and sugar content of organic and conventional fresh produce.

Fresh Produce	Soluble Solids Content		References
	Organic	Conventional	
Apples	Starking Delicious: 12.66 (Brix)	Starking Delicious: 12.40 (Brix)	[23]
Strawberries	Diamante: 8.97, Lanai: 8.98, and San Juan: 8.96 (Brix)	Diamante: 7.68, Lanai: 9.52, and San Juan:8.71 (Brix)	[22]
Tomatoes	Redondo: 4.38 (Brix)	Redondo: 4.46 (Brix)	[6]
Beetroots	Libero: 6.0–7.4 (g/kg FW)	Libero: 6.1–6.3 (g/kg FW)	[3]
Lettuce	Caipira: 28–29 (g/kg)	Caipira: 36 (g/kg)	[4]
Sweet peppers	Green: 3.8, red: 5.8 (Brix)	Green: 4.4, red: 7.6 (Brix)	[24]
Sugar content			
Apples, pears, carrots, blackcurrants,	Red Boskoop (apples): 7.9, Bartlett (pears): 6.9, Tiben (blackcurrants): 7.7, Perfection (carrots): 5.6,	Red Boskoop (apples): 9, Bartlett (pears): 6.7, Tiben (blackcurrants): 7.5, Perfection (carrots): 7.1,	[28]

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Fresh Produce	Soluble Solids Content		References
	Organic	Conventional	
beetroots, and celery	Czerwona Kula (beetroots): 8.4, and Jabłkowy (celery): 1.3 (%)	Czerwona Kula (beetroots): 5.9, and Jabłkowy (celery): 0.6(%)	
Tomatoes	Merkury, Akord, Rumba: 85.22 (g) Picolino and Conchita: 88.93 (g)	Merkury, Akord, Rumba: 83.48 (g) Picolino and Conchita: 78.12 (g)	[16]
Beetroots	Libero: 131.1–142.6 (g/kg FW)	Libero: 125.8–129.6 (g/kg FW)	[3]
Cabbages	Sufama F1: 6.59 (g/100 g FW)	Sufama F1: 6.63 (g/100 g FW)	[29]

compared with the conventionally grown ones [3][28][16] (Table 2). Organic fruits contain less sugar [30] due to less Na, because Na treatment enhances the sugar content [31]. In contrast, the increased sugar content was found in conventional strawberries, apples, carrots, and cabbages [22][28][29]. Guilherme et al. [24] found that conventional and red peppers showed higher total soluble solids than the organic and green ones. The increase and decrease in sugar content may be influenced by crops, cultivars, treatment, and maturity of fresh produce.

4.3. Dry Matter Content

Organic melons, tomatoes, potatoes, beets, and watermelons showed increased dry matter [28] and conventional strawberries, wheat, barley, faba beans, and lettuce exhibited high dry matter [32][33] (Table 3). Organic cabbages, red beets, peppers, tomatoes, and potatoes showed high dry matter content [24][19][34]. Moreover, the perilla and cabbage total dry matter content is higher in organic produce than in the conventionally grown one [29][35]. The dry matter content increases and decreases may happen due to water absorption by the plant. There was no difference in the water content of organic and conventional plums [30].

Table 3. Dry matter and dietary fiber content of organic and conventional fresh produce.

Fresh Produce	Dry Matter Content		References
	Organic	Conventional	
Wheat, barley, faba beans, potatoes	Wheat: 89.4, barley: 89.5, faba beans: 88.1, potatoes: 19.2 (%)	Wheat: 89.6, barley: 90.3, faba beans: 87.9, potatoes: 20.5 (%)	[32]
Apples, pears, carrots, blackcurrants, beetroots, and celery	Red Boskoop (apples): 12.4, Bartlett (pears): 12, Tiben (blackcurrants): 15.2, Perfection (carrots): 9.7, Czerwona Kula (beetroots): 12.2, and Jabłkowy (celery): 10.4 (%)	Red Boskoop (apples): 13.4, Bartlett (pears): 11.2, Tiben (blackcurrants): 12.6, Perfection (carrots): 10.4, Czerwona Kula (beetroots): 8.3, and Jabłkowy (celery): 8.9 (%)	[28]
Bell peppers	Roberta: 82.2 (g/kg)	Spartacus: 75.9 and Berceo: 78.4 (g/kg)	[19]
Beetroots	Libero: 163.7–182.4 (g/kg FW)	Libero: 163.7–182.4 (g/kg FW)	[3]

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Fresh Produce	Dry Matter Content		References
	Organic	Conventional	
Cabbages	Sufama F1: 9.22 (g/100 g FW)	Sufama F1: 8.81 (g/100 g FW)	[29]
Sweet peppers	Green: 6.38, red: 5.87 (%)	Green: 4.98, red: 5.03 (%)	[24]
Dietary fiber content			
Grapes	Flour: 62.70 (%)	Flour: 69.70 (%)	[36]
Pumpkins	2.68 (%)	2.47 (%)	[37]
Talinum triangulare	42–79 (g/100 g Deionized water, DW)	40–73 (g/100 g DW)	[38]
Sweet peppers	Green: 11.4, red: 9.23 (%) [39]	Green: 11.6, red: 10.3 (%) [40]	[24]

... However, conventional potato tubers had more dry matter than organic tubers [41]. There is no difference in the dry matter content of beetroots, cabbages, and carrots [3].

4.4. Dietary Fiber

Conventional plums, grapes, and wheat performed better in total dietary fiber and soluble fiber than the organic ones [30][36] (Table 3). In insoluble fiber, no differences between organic and conventional plum cultivation systems were found. The total dietary fiber content of the conventional Bordô grape flour and pumpkins was higher than of the organic ones [36][37]. Fruits and vegetables are a good source of dietary fiber. They are rich in bioactive compounds, which reduce the bioavailability of fat in the human diet. The dietary fiber might lower the bioavailability of carotenoids. Organically grown *Talinum triangulare* and pumpkins contained more dietary fiber than the conventionally grown ones [37][38]. The most important is the growth/differentiation balance (GDB) hypothesis. Growth denotes the production of roots, stems, and leaves or cell division and elongation; differentiation indicates the enhancement of the structure or function of the existing cells [42]. In the case of the GDB hypothesis, growth and differentiation are necessary for primary and secondary metabolism [43]. Secondary metabolites, i.e., [illegible] in grapes [44]. The conventionally grown sweet peppers showed higher fiber content than the organic ones at both the green and the red maturity stages [24].

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