

Evaluation of health quality of vegetables sourced from organic and conventional production. Part 1. Introduction

Ocena jakości zdrowotnej warzyw pozyskiwanych z produkcji ekologicznej i konwencjonalnej. Część 1. Wprowadzenie

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Praca stanowi zbiór informacji na temat jakości zdrowotnej warzyw pochodzących z systemu gospodarowania ekologicznego i konwencjonalnego. Warzywa są bogatym źródłem związków wykazujących właściwości odżywcze oraz prooksydacyjne, ale spożywanie tych produktów w zbyt dużych ilościach może również spowodować nagromadzenie w organizmie człowieka substancji o charakterze antyodżywczym i toksycznym. Z tego powodu wiele badań prowadzonych w Polsce i Europie miało na celu kontrolę jakości żywności produkowanej w systemie ekologicznym i konwencjonalnym. W wielu doniesieniach naukowych sugeruje się spożywanie warzyw ekologicznych, co jest gwarancją dla konsumenta pozyskania żywności pozbawionej szkodliwych związków chemicznych, jakimi są pozostałości pestycydów oraz mineralnych nawozów stosowanych w rolnictwie konwencjonalnym na rzecz m.in. związków fenolowych czy witaminy C. Promocja zdrowego stylu życia poprzez spożywanie żywności ekologicznej o znakomitych właściwościach organoleptycznych jest w Polsce zjawiskiem stosunkowo nowym, czego dowodem jest duża jeszcze niewiedza konsumentów na rynku ekologicznych produktów żywnościowych. Żywność z gospodarstw ekologicznych wykazuje wiele walorów zdrowotnych, odżywczych i sensorycznych w porównaniu z żywnością wyprodukowaną w systemie konwencjonalnym. Przede wszystkim zawiera mniej związków azotanowych, metali ciężkich oraz pozostałości pestycydów, natomiast większą zawartość niektórych witamin, głównie kwasu askorbinowego i wartościowego białka. Istnieją również doniesienia, które nie potwierdzają takich różnic lub wykazują tendencje odwrotne. Dlatego konieczne jest kontynuowanie badań w celu pełnego wyjaśnienia wpływu surowców ekologicznych na zdrowie człowieka.

Słowa kluczowe: warzywa, ekologia, konwencja

This work is a collection of information about the health quality of vegetables from organic and conventional farming. Vegetables are a rich source of compounds with nutritional and prooxidative properties but their consumption in large quantities can also lead to the accumulation of antinutritional and toxic substances in a human body. For this reason, many studies conducted in recent years in Poland and Europe were aimed at quality control of food produced by organic and conventional systems. Many scientific reports recommend the consumption of ecological vegetables as the food free from harmful chemicals, such as pesticide residues and mineral fertilizers used in conventional agriculture, and rich in phenolic compounds and vitamin C. In Poland, the promotion of a healthy lifestyle via the consumption of organic food, with excellent organoleptic properties, is a relatively new phenomenon, as evidenced by still large ignorance of consumers on organic food products.

Foods from organic farms have many health, nutritional and sensory benefits as compared with foods produced in the conventional systems. They contain fewer nitrate compounds, heavy metals and pesticide residues, while they have higher contents of certain vitamins, especially ascorbic acid and valuable proteins. However, reports are also available that do not confirm such differences or even show reversed trends. Therefore, studies should be continued to fully explain the influence of organic products on human health.

Key words: vegetables, ecology, convention

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Introduction

In the 21st century there is a growing awareness of the dangers resulting from environmental pollution. For this reason, many studies conducted in recent years in Poland and Europe were aimed at quality control of food produced by organic and conventional systems. The nutritive value of food comprises the following properties: nutritive value of the product, organoleptic quality, and importance in maintaining the health of

consumers. Thus, the nutritive value does not only mean the content of biologically-active compounds, vitamins, minerals, proteins, sugars and essential oils, or compounds of antioxidative properties neutralizing free radicals, but also the content of anti-nutritive and xenobiotic substances, which in large quantities may be harmful to human health, e.g. nitrate (V) and (III) and heavy metals (Pb⁺², Cd⁺², Zn⁺², Cu⁺²).

Previous studies demonstrated that vegetables, specifically green leafy vegetables, provide the greatest amount of toxic metals, and a slightly lower amount in case of brassicas and root and bulb vegetables [1-3]. The results of the study by Czech and Rusinek [2] demonstrated a higher content of lead and cadmium in lettuce from allotments in the center of Lublin at the level of 0.202 and 0.027 mg kg⁻¹ FW, respectively, while a smaller amount in spinach (0.142 and 0.06 mg kg⁻¹), and chive (0.09 and 0.006 mg kg⁻¹). They noted similar tendency with respect to the content of heavy metals in vegetables acquired from the supermarkets. The study of Śmiechowski and Florek [4], on the content of heavy metals in vegetables, found the highest content of copper in vegetables from conventional culture, i.e. 0.56 and 0.57 mg kg⁻¹ FW in potatoes and carrots, respectively, and 1.53 mg kg⁻¹ FW in parsley. The lowest content of this metal was found in vegetables from organic farming, where it amounted to 0.21 and 0.27 mg kg⁻¹ FW in carrots and potatoes, respectively, and 0.08 mg kg⁻¹ FW in parsley. In the study of these authors [4], a lower zinc content was also reported in carrots and parsley grown in the organic system (by 45.5% and 2.52%, respectively) as compared to the conventional vegetables. Only conventionally cultivated potatoes had a lower content of zinc (by 7.2%).

The work of Rutkowska [5] presented the results of research on the content of nitrates (V) and (III) in vegetables from organic and conventional farming and the ones purchased in stores with so-called “healthy food”, including: beets, turnips, white and red cabbage, carrots, parsley, leeks, celery, onion, and potatoes. The study showed the highest content of nitrates (V) in the conventional vegetables. A high level of nitrates (V) exceeding 2000 mg NaNO₃/kg of fresh weight was found in beets (I group).

Most of the studies that compared the nutritive value of vegetables from organic and conventional farming are limited to a small group of compounds, mainly minerals, proteins, sugars, and certain vitamins [6]. However, a fair comparison of the nutritive value of vegetables from different farming systems requires the consideration of genetic, environmental, and post-harvest factors.

A genetic factor is the variety of plant products, an environmental factor is the type and structure of the soil, the type of fertilizers and methods of their application, climate, farming practices such as the use of pesticides, irrigation and cultivation method, while a post-harvest factor is the crop maturity determining the time of the harvest, storage and processing methods. Most of the published works on this subject do not meet such criteria, which is detrimental to the reliability of the results [7]. Heaton [8] analyzed 99 studies, out of which 29 were addressing a quantitative

comparison of the chemical composition of crop yields obtained in both systems, while the mineral composition was compared in 14, the dry matter content in 19, and vitamin C in 13 of the studies.

An invaluable addition to the research on the nutritive value of the analyzed vegetables from organic and conventional cultivations is their sensory analysis, where the dominant role is played by genetic factors – the type of the cultivar and ripeness of the product followed by environmental and post-harvest factors. In the world literature there are several studies that concerned sensory investigations in organic and conventional vegetables. Among the studies published in Polish literature that compared organoleptic qualities of vegetables grown in organic and conventional systems, only those that included the factors influencing their sensory properties and cultivation conditions are more reliable [9]. The results of the survey by Kazimierczak and Świetlikowska [10] confirmed certain attributes of food choices. In the opinion of 542 respondents, most important were the taste values (52.9%), appearance (65.7%) and freshness (48.2%) of the product while the organic production was a critical factor for only about 10% of the respondents. Little interest in buying organic food is conditioned by low environmental awareness of consumers, which is confirmed by the declaration of vegetable purchase in organic food stores by only 2.8% of the respondents (Figure 1). Over 30% of the consumers also responded that the prices of organic vegetables in Poland as compared to conventional vegetable prices were too high, or high (Figure 2).

For the consumer, the ecological cultivation of vegetables is a guarantee of safe and high quality food, free of harmful chemicals such as pesticide residues and mineral fertilizers used in conventional agriculture [11]. This is due to the fact that the plants grown by conventional methods, absorbing fertilizers, especial-

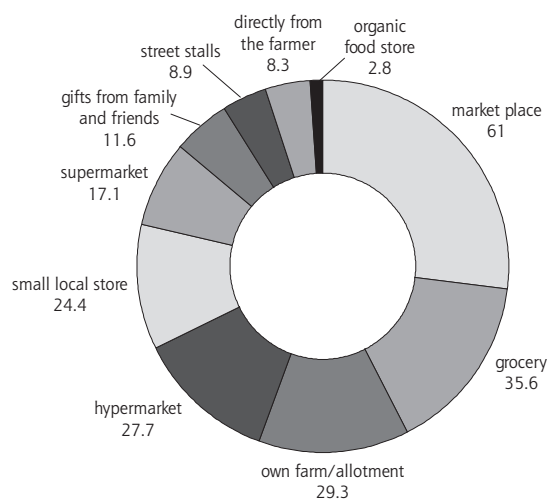


Fig. 1. Preferred sites of vegetables purchase expressed in % of answers of respondents choosing a particular place (Kazimierczak and Świetlikowska)

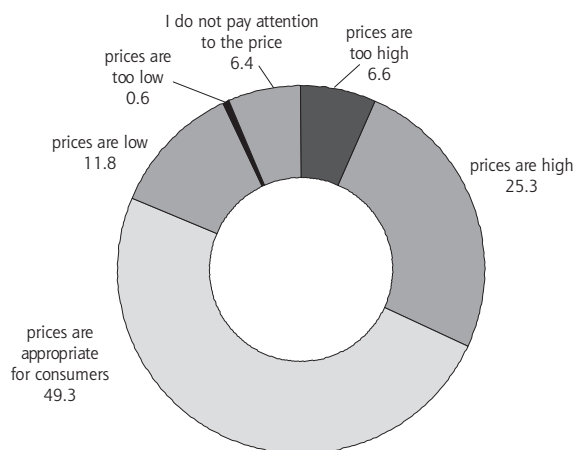


Fig. 2. Subjective evaluation of prices of fruit and vegetables (Kazimierzak and Świetlikowska)

ly nitrogen, will produce more nitrogen compounds (amino acids, peptides, proteins and certain alkaloids). In ecological farming where use is made of organic fertilizers, plants direct their metabolism towards the production of carbon compounds such as sugars, phenolics or vitamin C [12, 13]. A general comparison of the effect of inorganic and organic fertilizers on the content of some of the components (predominantly statistically verified), e.g. vitamin C or sugars in various vegetables, showed no significant differences in most of these studies [14-17]. Therefore, studies carried out in Poland and Europe and showing a similar trend are ambiguous and require further investigation. Moreover, the authors often use various experimental techniques that are not compatible with each other, which make the results difficult to compare. Furthermore, some of the results are simply questionable.

One of the main problems faced by organic producers is low awareness of the consumers about this type of food as compared to conventional nutrition. Although, with the development of this market, the share of consumers buying organic food regularly increases, it is still relatively low in Poland [18]. Therefore, one of the important research tasks is to answer the questions about the factors determining the continuation of the market growth. It is important, from the viewpoint of decision-making by consumers, to identify a set of subjective characteristics of organic food and their hierarchy. The perception of food by consumers is influenced mainly by the production process, value of the product in a given branch of the food economy from production through processing and distribution. However, on the other hand, the food itself determines, to some extent, specific adaptive processes in particular branches of the food industry. Perception affects consumer preferences, and largely determines the purchasing decisions. Knowledge of consumer's perception has not only educational but also the practical value as it may be helpful in marketing, especially in the construction of organic food promotion strategy aimed at creating additional

demand. The second problem is that organic products are sold at prices higher than conventional products. In Poland, there is no regular testing of organic and conventional vegetables from retail as well as from vegetable wholesalers. The results of such research could be utilized as a tool influencing consumer knowledge, awareness, attitudes and behavior. It should be noted that during the development of organic food market, the demand depends on the dissemination of information created in part by research institutions. The studies on organic and conventional food possess important cognitive significance, because vegetables such as parsley, celery, parsnip, cabbage, kohlrabi and onions, leeks and garlic are the basic and most popular group of products, being in the focus of interest to consumers entering this market. In the future, the sole period of appropriate storage of vegetables will be appreciated, because of the preservation of high-quality biological value of these products. Storage allows for continuous supply of the market with fresh vegetables throughout the year, helps to stabilize prices, to increase exports and improve profitability.

The global market for organic food is growing rapidly and in Poland there is also a huge potential for the growth of this market. The Lublin voivodeship is a region particularly suitable for organic production on a large scale due to its rural character. A large number of forests, natural parks, nature reserves and natural water bodies in the vicinity of the ecologically pure fields, make the Lublin province a suitable region for the production of natural, uncontaminated agricultural products [11]. The problem of storage of organic and conventional vegetables is now one of the most important issues in the broad area of agriculture. This is because of the growing demand and interest from consumers, not only in fresh product, but also stored food. Promoting a healthy lifestyle, proper nutrition, and personal responsibility for the state of health, is however, still a relatively new phenomenon in Poland.

Many studies conducted in recent years in Poland and worldwide showed that organic vegetables contain more bioactive compounds and vitamin C valuable to health as compared to the conventionally grown vegetables. In fresh tomatoes grown in the organic system, Caris-Veynard et al. [19] reported a higher content of vitamin C, carotenoids and polyphenols (except for chlorogenic acid) than in vegetables grown conventionally. The study of Hallmann and Rembiałowska [20] demonstrated that organic farming methods had a significant effect on the accumulation of vitamin C and total sugars. The onions from organic farming contained significantly more ascorbic acid – 28.14 mg% as compared to conventionally cultivated onions – 12.24 mg%. Wenta and Red Baron onions from organic farming contained significantly more total sugars than those derived from conventional cultivation and these values amounted to 3.22% and 1.70%, respectively. Neverthe-

less, Masamba and Nguyen [21] found no differences in vitamin C content between cabbage and lettuce from both tillage systems. Similarly, Fjellner-Moding et al. [22], within 6 years of research detected no differences in the content of ascorbic acid in vegetables grown organically and conventionally. Schuphan [23], in the comparative 12-year studies over the sensory properties of vegetables also failed to find significant organoleptic differences between organic and conventional cultivation. It has been shown, however, that the sole labeling of vegetables as "organic product" and their higher price, raise the confidence of consumers of their excellent organoleptic properties [24], which indicates that high ignorance of consumers is still a problem in the market of organic food products.

Summary

Foods from organic farms have many health, nutritional and sensory benefits as compared with foods produced in the conventional systems. They contain fewer nitrates (V) and (III), heavy metals and pesticide residues, and higher contents of certain vitamins, especially vitamin C and valuable proteins. In addition, organic products have a higher quality of taste and smell, which is also important for consumers. However, reports are also available that did not confirm such differences or even showed reversed trends. Therefore, studies should be continued to fully explain the influence of organic products on human health.

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