

Psychological factors distorting perceptions of hydroponic vegetables and limit their popularity

*Elizaveta Naydenova*¹, *Evgeny Pronenko*^{2*}, and *Sofia Ovdienko*¹

¹Southern Federal University, 344006, Rostov-on-Don, Russia

²Don State Technical University, 344002, Rostov-on-Don, Russia

Abstract. Amid modern global demographic and environmental trends, significant changes are occurring in the field of agriculture. Intense urbanization and challenges posed by climate change make the adoption of sustainable agricultural practices necessary, particularly in crop production. Hydroponics, as a method of growing crops, offers several advantages, and the vegetables and fruits produced on soil-less farms are comparable in quality to those grown on traditional farms. However, despite these benefits, many consumers continue to view hydroponic vegetables and fruits with skepticism. Our data indicates that a substantial number of consumers believe hydroponic vegetables are less natural than those grown through conventional means and perceive them as less nutritious. In fact, a lot of Russian buyers still prefer to consume traditionally grown production. The reasons for this preference include low awareness, neophobia, and general rejection of hydroponic farms. To change consumers' attitude towards hydroponic vegetables, it is essential to enhance public understanding of hydroponics, utilize labels that emphasize the naturalness and health benefits of such products, and modify the design of hydroponic farms to align with consumers' preferences.

1 Introduction

Against the backdrop of current global demographic and environmental trends, significant changes are taking place in the field of agriculture. Rapid urbanization and the challenges posed by climate change are driving the need for sustainable agricultural practices. In the early twentieth century, the world population was around 1.5 billion people; today, it has exceeded 8 billion, and according to sociologists, it is expected to grow to 9.7 billion by 2050 [1]. This rapid population growth leads to numerous problems associated with the inefficiency of food systems [2]. Consequently, there is an urgent need for industrialists to find ways to increase productivity in agriculture.

The necessity to enhance agricultural productivity is particularly pressing for several reasons. First, the exclusive use of traditional crop production technologies has led to the intensive application of fertilizers and pesticides, which saturate the soil with unsafe

* Corresponding author: heimag@yandex.ru

chemicals. As a result, many plots of land become unsuitable for cultivation after several seasons of operation.

Additionally, climate change is causing many agricultural regions to experience severe droughts. Furthermore, genetically modified products cannot fully meet market demands, and their effects on human health remain the subject of ongoing research and debate [3].

For these reasons, urban agriculture, particularly hydroponics, is emerging as a promising solution to address existing food challenges.

The term "hydroponics" coined by Professor William Guericke in the early 1930s, derives from the Greek words "hydro" (water) and "ponos" (labor) [4]. In fact, hydroponics refers to an innovative agricultural method that involves growing plants without using traditional soil media (Fig. 1). Hydroponics refers to an innovative agricultural method that involves growing plants without traditional soil media (Fig. 1). Instead, it utilizes water, nutrient solutions, and oxygen to nourish and sustain plant growth, representing a groundbreaking approach to horticulture that is revolutionizing traditional farming practices .



Fig. 1. Example of a hydroponic farm

Although the basic principles of hydroponics are not new and have been employed in traditional commercial greenhouses for the past four decades, the technology underlying hydroponics has undergone significant advancements since then. Hydroponic systems can be classified into those designed for growing in water and those utilizing a growing medium in greenhouse conditions. In aqueous cultivation systems, plants are either suspended directly in a nutrient solution or their roots are misted with a solution (as in aeroponics) [5]. These systems can be open, where the solution flows past the roots without being reused, or closed, where excess solution is collected and recycled.

The composition and concentration of nutrients in the mixture are determined and regulated by the manufacturer, which is one of the main advantages of the hydroponic method. Today, almost no significant project in the field of crop production can proceed without incorporating hydroponics [3].

It is noteworthy that hydroponic systems, which eliminate the need for soil, offer significant environmental advantages over traditional agriculture. With the ability to reduce

resource waste and combat soil degradation, hydroponics provides a number of benefits. For example, the advantages of the hydroponic method of growing vegetables include:

1. **Rapid Plant Growth:** Plants in hydroponics grow faster due to optimal control of nutrients and environmental conditions.

2. **Space Efficiency:** Unlike traditional methods, which primarily rely on horizontal cultivation, hydroponics effectively utilizes both horizontal and vertical spaces. This innovative approach not only increases overall yield per unit area but also aligns with the emerging trend towards vertical farming [6].

3. **Cleanliness and Absence of Pests:** Minimizing soil use reduces the risks of pests and diseases.

4. **Water Conservation:** Hydroponics uses 90% less water compared to traditional farming methods.

5. **Year-Round Production:** Vegetables and fruits can be grown at any time of the year, regardless of climatic conditions.

6. **Material Resource Savings Over Time:** According to researchers, hydroponics can lead to material resource savings of 70% to 90%, depending on the type of crop and hydroponic system, in comparison with traditional cultivation methods [7].

At the same time, hydroponics has significantly fewer disadvantages than advantages. Among the commonly cited drawbacks of the hydroponic cultivation method are the following:

1. **High initial costs** - Installation of a hydroponics system requires a significant investment in equipment.

2. **Vulnerability to equipment failures** - Failure of an irrigation or climate control system can lead to rapid plant death.

3. **Limited range of crops** - Not all plants can be successfully grown using hydroponics [8].

As highlighted in this brief overview, hydroponics is a convenient and environmentally friendly method of crop production that potentially has the capacity to replace traditional methods of growing vegetables and fruits. However, despite the numerous advantages of this technology, hydroponic vegetables are not very popular among consumers in Russia [9]. Therefore, it seems essential to understand the peculiarities of consumer perceptions regarding hydroponic vegetables as an alternative to traditionally grown crops. In this study, we aim to identify the fundamental factors that influence consumer choices when selecting vegetables and fruits.

2 Methods

A total of 70 Russians aged 18 to 65 years (30 men and 40 women) participated in the study. We utilized an author-designed questionnaire aimed at assessing respondents' attitudes toward hydroponic vegetables as our methodological tool.

The author's questionnaire included the following questions:

1. How often do you eat vegetables?

2. How do you feel about the use of modern technologies in agriculture?

3. Do growing methods affect your perception of vegetables?

4. Do you agree with the statement that hydroponic vegetables seem less natural than traditional ones?

5. Do you think hydroponic vegetables can become a full-fledged replacement for traditional vegetables?

6. Do you believe that hydroponic vegetables can be as healthy as traditional vegetables?

7. Is the labeling of the product indicating the method of cultivation important to you?

8. When you try vegetables, what criteria are important to you when assessing their quality?

9. How do you feel about vegetables growing without traditional soil?

3 Results

To begin with, most of our respondents are active consumers of vegetables (n=48), indicating a high demand for these products. Overall, despite a positive attitude towards innovative methods of crop production, many respondents believe that the method of growing vegetables and fruits affects their perception (n=43). This is evident in the fact that over half of the respondents (n=40) perceive hydroponic vegetables as less natural than conventionally grown ones. Furthermore, many respondents (n=37) feel that although hydroponic plants can serve as a replacement for traditionally grown vegetables and fruits, they are still considered less nutritious. However, only 28 respondents reported exclusively negative reactions, such as distrust, fear, or skepticism, towards hydroponic vegetables.

These findings suggest that many consumers, despite their doubts about the nutritional value of hydroponic vegetables, are still willing to purchase them due to a lack of alternatives. Nonetheless, Russian buyers are generally more inclined to consume plants grown in more traditional and familiar ways.

4 Discussion

In our previous study on alternative sources of protein, we highlighted potential reasons for people's distrust of unconventional food production methods. We identified neophobia, disgust, and low awareness as the main reasons for consumers' rejection of non-standard types of meat. We believe that similar factors may also hinder individuals from buying and consuming hydroponic vegetables.

In addition to the factors mentioned, some authors emphasize the importance of the "degree of pleasantness" [1] when consumers choose traditional vegetables. The degree of pleasantness refers to the perception of the farming method, based on the subjective evaluation of the overall farm type and its material infrastructure. This degree is influenced by factors such as whether a person considers the farm to be clean, if they desire it to be clean, and how it is arranged (for example, built from wood, in a rustic style, or from metal, plastic, and other materials that define its structure) [1]. Therefore, we can conclude that if the degree of pleasantness influences Russians' willingness to purchase hydroponic vegetables, manufacturers should strive to enhance the attractiveness of hydroponic farms for consumers.

Another significant factor influencing perceptions of hydroponic vegetables, according to researchers, is the subjectively perceived naturalness and environmental friendliness of the product and its production process. People are more likely to buy products labeled as "natural," as they believe these are healthier and do not contain harmful synthetic substances. This preference reflects the desire of most consumers to purchase healthy, environmentally friendly products. Consequently, manufacturers can boost the appeal of hydroponic vegetables through appropriate labeling.

The study by Strengers, Y. & Maller, C. [8] outlines the concept of the theory of social practice. According to the authors, people tend to adhere to everyday habits in any actions. The desire to follow a certain plan, order of actions during the day, saves a person from having to adapt to changes even in insignificant things. Such behavior may underlie neophobia, which will limit the desire to try hydroponic products. This can also lead to a low awareness of hydroponic vegetables and fruits: a person who does not want to try something

new simply does not need to study it. Accordingly, hydroponic vegetable producers should independently try to raise consumer awareness about hydroponic vegetables.

5 Conclusion

Research shows that preferences for hydroponic vegetables are shifting as people become more aware of innovative crop production methods. In light of growing environmental concerns, consumers are increasingly interested in products and services that contribute to environmental preservation. Consequently, the "naturalness" of a product and its production methods have become key factors in consumers' decision-making processes.

Concern for personal health is also a significant reason many people opt for familiar products. There is a notable increase in consumers' willingness to spend money on goods and services that benefit both personal health and the environment. This trend highlights consumers' readiness to pay a premium for products that contribute positively to human health and ecological sustainability.

Sustainable food production is crucial for the future, as it is necessary to ensure a balance between human health and environmental sustainability. This involves considering the physical, mental, and social well-being of individuals and communities, as well as protecting ecosystems from the impacts of human activities.

Given this data, hydroponic vegetable producers should strive to educate consumers about the benefits of hydroponics while also enhancing the attractiveness of their farms. This is essential for combating neophobia, which often hinders consumers when choosing hydroponic products and will ensure correct meaning regulation in conditions of uncertainty [9, 10].

References

1. S. Araya, Identifying food labeling effects on consumer behavior. *Marketing Science* 41(5), 982–1003 (2022)
2. S. N. Bolotovskiy, S. R. Baymukhambetov, E. V. Demchuk, Pros and cons of hydroponics. *New Science: Current State and Development Paths*, 12(4), 46–48 (2016)
3. L. Ivascu, The perception and degree of adoption by urbanites towards urban farming. *Sustainability* 13(21), 12151 (2021)
4. M. Kannan, Hydroponic farming – A state of art for the future agriculture. *Materials today: proceedings* 68, 2163–2166 (2022)
5. S. Roman, L. M. Sánchez-Siles, M. Siegrist, The importance of food naturalness for consumers: Results of a systematic review. *Trends in food science & technology* 67, 44–57 (2017)
6. A. Sadov, K. M. Potetnya, A. I. Noskov, Design of a rotary hydroponic installation with an automated process for growing crops. *Scientific and Technical Bulletin of Technical Systems in the Agro-Industrial Complex* 3(3), 39–45 (2019)
7. H. B. E. Sales, *Advances in Agricultural Technology: A Review of Slow-Release Nanofertilizers and Innovative Carriers*. *Communications in Soil Science and Plant Analysis* 55(12), 1849–1882 (2024)
8. Y. Strengers, C. Maller, Integrating health, housing and energy policies: social practices of cooling. *Building Research & Information* 39(2), 154–168 (2011)
9. I. V. Abakumova, M. V. Godunov, E. V. Belova, N. E. Komerova, Features of teachers' meaning-based regulation under conditions of information uncertainty.

Russian Psychological Journal 19(1), 101–111 (2022)

<https://doi.org/10.21702/rpj.2022.1.8>

10. N. N. Mironenkova, Psychological aspect of the study of the problem of value-semantic choice. Innovative science: psychology, pedagogy, defectology 1(1), 133–143 (2018)