REVIEW ARTICLE

**Eurasian Journal of Medical and Biological Sciences**
**AN INTERNATIONAL JOURNAL**
Eurasian J Med Biol Sci **4(2): 63-70**

# Microgreens: A Innovative Source of Aesthetics and Nutritional Value in Gastronomy

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Received : 04/11/2024 Revised : 27/11/2024 Accepted : 01/12/2024

**ABSTRACT:** In recent years, chefs in the field of gastronomy have begun to adopt the use of microgreens in their dishes as a new trend. Microgreens are nutrient-rich foods enriched with components such as potassium, vitamins, minerals, and antioxidants. The consumption of these plants can contribute to reducing cancer risk and improving hormonal balance. Additionally, their higher phytochemical, mineral, and vitamin content compared to mature plants means that incorporating them into diets can significantly enhance nutritional quality. As much as the quality and flavor of food in restaurants are essential, the increasing consumer interest in food presentation and the demand for healthy ingredients are gaining importance. Chefs aim to provide exotic flavors, appealing colors, and health benefits through the use of microgreens. In this context, microgreens not only enhance flavor, color, and texture in salads but are also regarded as functional foods due to their rich phytochemical content. The demand for microgreens in the food industry has been steadily increasing over time. This rise is linked not only to innovations in the gastronomic world but also to the growing awareness of healthy eating. Chefs are making microgreens an indispensable part of their kitchens by offering consumers more attractive and nutritious meals. Thus, microgreens play a significant role in preparing dishes that are both aesthetically pleasing and rich in nutritional value. This review study aims to explore microgreens and their use in the field of gastronomy.

**Keywords:** Functional Food, Gastronomy, Healthy Eating, Microgreens, Plant-Based Nutrition.

## INTRODUCTION

Health is not merely the absence of disease but rather a state of physical, mental, and social well-being (Brüssow, 2013). Health is influenced by both genetic factors, passed down through generations, and environmental factors. Genetically healthy individuals are described as those who are physically well-developed and mentally competent. Environmental factors, on the other hand, include nutrition, living conditions, educational opportunities, the physical environment, and cultural resources (Şahin, 2014). Nutrition plays a crucial role in taking preventive measures to maintain and improve health. The process of nutrition, which begins from the onset of pregnancy, is necessary for sustaining life until the end of an individual's existence (Özüpek and Arslan, 2021). Nutrition helps individuals grow and develop healthily, maintain their health, and improve it (Rodríguez-Mañas et al., 2023). Diseases and psychological conditions negatively affect nutrition (Ueshima et al., 2023). The energy, carbohydrates, proteins, and fats that a person requires from food vary depending on factors such as gender, age, height, and weight. For healthy growth and development, individuals need to consume a balanced and adequate diet (Baysal, 1996).

Along with the importance of nutrition, the production of food and beverages is advancing, positioning gastronomy as a significant field of study (Birdir and Akgöl, 2015). Since ancient times, with the discovery of fire, cooking food—such as roasting meat and boiling wild plants—has continued to evolve, laying the foundation for the concept of the kitchen (Dilsiz, 2010). Over time, the science of gastronomy has emerged alongside the development of culinary practices. Etymologically, the term 'gastronomy' is derived from the words *gaster* (stomach) and *nomos* (law) (Santich, 2004). Gastronomy encompasses the entire process from food and beverage production to systematic progression and consumption (Dülger Altıner and Özdemir, 2019). It also includes culture, geography, society, and social interaction (Güleç, 2021). It is defined as the development of food and beverages, along with efforts to adapt them to the conditions of the time, under the guidance of both art and science (Aksoy and Sezgi, 2015). Over time, gastronomy has continuously renewed itself and continues to evolve today (Işkın, 2020). With the advancement of science and technology, new cooking techniques have emerged in gastronomic practices, contributing to the development of culinary arts (Çarbuğa and Memiş Kocaman, 2018).

As gastronomy has progressed, the processing and presentation of functional foods have also gained importance (Al Zuhairi and Doğan, 2021). Functional foods are described as nutrient-rich foods that support human health and have positive effects on both the physical and mental well-being of individuals (Şimşek and Keşkekci, 2023). Recently, with the increasing knowledge and interest of consumers, functional foods have found a place in gastronomy both globally and within Türkiye (Çirişoğlu and Olum, 2019).

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Plants are essential sources for nutrition and the maintenance of health (Doğan, 2020; Erkorkmaz et al., 2023; Göldağ and Doğan, 2024; Knez et al., 2024). Among functional foods, microgreens stand out for their high nutritional value and their role in promoting health (Ebert et al., 2014; Bhaswant et al., 2023; Gunjal et al., 2024). Microgreens are defined as young, tender edible seedlings that fall under the category of vegetable products (Renna et al., 2017). They are typically described as plants that are fully developed in terms of cotyledons and measure between 2.5 to 7.6 cm in height (Domínguez-Domínguez et al., 2021). They refer to the immature greens of weeds, grains, or vegetables and are harvested when the first true leaves appear (Caracciolo et al., 2020). These seedlings can be consumed after being harvested 7–14 days post-germination, when the seeds have sprouted (Turner et al., 2020).

Microgreens are noted for their rich content of vitamins, minerals, and antioxidant compounds (Shibaeva et al., 2022). Compared to mature plants, microgreens contain higher concentrations of secondary metabolites such as amino acids, anthocyanins, polyphenols, carotenoids, and ascorbic acid (Marchioni et al., 2021). In addition to their nutritional content, microgreens are also intriguing due to their vibrant colors, texture, and flavors (Renna and Paradiso, 2020). They are considered a novelty in the culinary industry and are often added to sandwiches, soups, salads, desserts, and beverages (Wojdyło et al., 2020).

Microgreens are identified as a new class of products that have gained popularity in recent years. They are typically consumed fresh, often used to garnish dishes or in salads, soups, and sandwiches. It has been observed that microgreens are suitable for indoor production and are part of the controlled environment agriculture movement (Turner et al., 2020). Another study mentions that LED lighting systems used in microgreen production help enhance plant growth and the synthesis of bioactive compounds (Shibaeva et al., 2022; Artés-Hernández et al., 2022; Livadariu et al., 2023).

Microgreens are said to come from various plant families and possess high nutritional quality, with the ability to be cultivated in sustainable environments. In addition to being popular garnishes, they have a wide range of potential applications in agriculture, health, and environmental sustainability. However, their acceptance by consumers, nutritional value, cost, and shelf life are important factors that determine their widespread use (Johnson et al., 2020). As consumer habits have changed and health awareness has increased, microgreen consumption has seen significant growth over time (Mir et al., 2017). With their rising popularity, microgreens have also made their way onto supermarket shelves and are being promoted in the media (Ebert, 2022). This review study aims to explore microgreens and their use in the field of gastronomy.

## TYPES OF MICROGREENS

Microgreens are grown from seeds of various species, including those from families such as *Amaranthaceae*, *Brassicaceae*, *Asteraceae*, *Chenopodiaceae*, *Lamiaceae*, *Apiaceae*, *Amaryllidaceae*, and *Cucurbitaceae*. The *Brassicaceae* family includes broccoli, cauliflower, watercress, cabbage, arugula, and radish; the *Asteraceae* family includes chicory, lettuce, and red chicory; the *Apiaceae* family includes carrot, dill, celery, and fennel; the *Amaryllidaceae* family includes onion, leek, and garlic; the *Amaranthaceae* family includes quinoa, spinach, beet, and amaranth; and the *Cucurbitaceae* family includes cucumber, squash, and melon. Additionally, microgreens are also cultivated from grains like rice, oats, wheat, corn, and barley, as well as from legumes like chickpeas, beans, and lentils (Sharma et al., 2020).

## MICROGREENS AND THEIR HEALTH BENEFITS

Over the past 20 years, there has been a growing interest in healthy eating and alternative products for health purposes (Kyriacou et al., 2016). Microgreens, described as young shoots rich in various nutrients, vitamins, minerals, and bioactive compounds, have garnered attention due to their high levels of vitamins, minerals, and antioxidant compounds that provide numerous health benefits (Shibaeva et al., 2022; Tallei et al., 2024; Rouphael et al., 2021). Research has shown that sprouted foods contain higher levels of vitamins, minerals, and bioactive compounds compared to unsprouted seeds (Kahve and Bayrak, 2023). Microgreens stand out for their nutrient-dense and functional value for human health, attributed to their rich phytonutrient content, including carotenoids, ascorbic acid, α- and γ-tocopherols, and phylloquinone (Kyriacou et al., 2019).

A study thoroughly examined the water content, color properties, antioxidant components, and volatile oil composition of microgreens. Results revealed that microgreens have a high-water content and elevated concentrations of chlorophyll and carotenoids, which contribute to their visual appeal (Marchioni et al., 2021). In addition, other phytochemicals like anthocyanins, glucosinolates, and carotenoids are found in higher concentrations in microgreens compared to mature plants (Paradiso et al., 2018).

Microgreens are also abundant in minerals, including iron, calcium, selenium, molybdenum, zinc, magnesium, and manganese (Michell et al., 2020; Dereje et al., 2023; Rizvi et al., 2023). Teng et al. (2021) explore the emerging role of microgreens as a vital component in human diets, emphasizing their rich nutritional profile, which includes vitamins, minerals, and antioxidants. They discuss how microgreens can improve health outcomes by preventing nutrient deficiencies and supporting the management of chronic diseases like cardiovascular conditions and diabetes. The review highlights the growing

interest in microgreens as a sustainable, nutrient-dense food source and advocates for their integration into modern diets to enhance public health and nutrition.

The health benefits of microgreens extend to disease prevention and recovery. They are beneficial in preventing or aiding the recovery process of diseases such as cardiovascular diseases, obesity, diabetes, and neurodegenerative disorders (Bhaswant et al., 2023). Zhang et al. (2021) review the nutritional quality and health benefits of microgreens, highlighting their higher concentrations of vitamins, minerals, and antioxidant compounds compared to mature plants. They emphasize microgreens' potential in addressing micronutrient deficiencies, preventing diseases like cancer and cardiovascular conditions, and improving overall health. Sharma et al. (2022) discuss the potential of vegetable microgreens as next-generation superfoods, focusing on their high nutritional value and health benefits. The review highlights advancements in genetic enhancement techniques to improve the nutrient profile of microgreens and examines their role in preventing chronic diseases. The authors also explore various processing methods to retain the bioactive compounds in microgreens, enhancing their utility as functional foods.

Microgreens are also proposed to play a role in preventing cardiovascular diseases due to their high nutritional and phytochemical content. They may help lower cholesterol and lipid levels, assist with weight management, and regulate inflammation. Furthermore, microgreens have shown protective effects against various types of cancer, including colon, lung, breast, gallbladder, and liver cancers. Their bioactive components can influence cancer cells by increasing reactive oxygen species production, arresting the cell cycle, and triggering apoptosis (Bhaswant et al., 2023)

## PROPAGATION OF MICROGREENS

The storage and consumption of microgreens are influenced by various culinary trends, and the selection of species is said to depend on consultations between producers and chefs as well as on the specific sensory preferences of customers (Sharma et al., 2020). One study highlights that microgreens have limited marketing strategies due to their rapid aging and short shelf life. However, with the increasing demand, efforts to extend their shelf life through various packaging and storage techniques have gained importance. As a result, microgreens have become a new culinary trend, recognized for their nutritious and flavorful qualities. Since microgreens are harvested from the soil surface, their roots are not consumed. They require sunlight and are grown in soil or other growing media. The seed density for microgreens is kept low because young greens need more space to grow and develop. Microgreens are harvested after growing under the sun and when the baby leaves emerge (Mir et al., 2017).

Another study describes microgreens as immature plants grown from the seeds of vegetables, grains, or herbs (Bhabani et al., 2024; Singh et al., 2024). They are typically harvested 7 to 21 days after germination. Their phytochemical content varies depending on the species, environmental conditions, and germination time. Due to their delicate textures, diverse colors, and high flavor profiles, microgreens are highly useful in the culinary industry (Wojdyło et al., 2020).

## MICROGREENS AND GASTRONOMY

In the past twenty years, there has been a growing interest in fresh foods, healthy eating, and nutritionally rich functional foods. Individuals are reportedly in search of innovations in culinary art that enhance health. This research highlights the significant impact of microgreens in enriching food contents and closely following gastronomic innovations (Kyriacou et al., 2016).

According to a study, chefs in San Francisco, California, began using microgreens in the 1980s, reflecting local industry trends. Microgreens are harvested just above the soil using scissors (Ramya et al., 2022) and are collected after germination. They are thought to add flavor to dishes with their smaller leaves that contain more taste and spice compared to baby vegetables (Rohini et al., 2016). The term "microgreens" was first documented in the United States in 1998 (Pattnaik et al., 2020).

Initially, there weren't many varieties available; however, arugula, basil, beet, and cilantro were among the early options. Today, numerous seed companies and producers in the United States offer a wide range of microgreens. A study reported that there are commercially available 25 types of microgreens, which can add value to new food products (Choe et al., 2018). In a study conducted by Nolte (2019) involving students of molecular gastronomy, students were asked to grow microgreens for a salad course. The microgreens grown were used to prepare various dishes based on the farm-to-table principle, promoting the use of microgreens.

A study by Galieni et al. (2020) indicated that in recent years, microgreens have gained popularity in home-cooked meals and the prepared food industry due to their nutritional value and health benefits. According to research by Chatterjee and Joshi (2020), the diversity and flavor of microgreens are increasingly attracting attention on media and supermarket shelves. The rise in ready-to-eat meal sales reflects a demand for healthy and convenient options. As a result, the popularity and use of microgreens are growing daily.

Microgreens are typically grown in controlled environments with high light, low humidity, and intense air circulation, and are usually cut just minutes before use. This ensures a longer shelf life, freshness, and high nutritional value. The most commonly used plant species include cabbage, radish, turnip, carrot, beet, Swiss chard, pea, broccoli, celery, amaranth, lettuce, chicory, arugula, mustard, sunflower, clover, Swiss chard, canola, chia, flax, fennel, dill, basil, and cilantro. These plants can be grown in greenhouse environments, directly in a restaurant kitchen, or at home. Microgreens are noted for their vibrant colors, delicate textures, and unique flavor-enhancing properties, which make them suitable for use in salads, sandwiches, soups, desserts, and beverages (Božić and Milošević, 2020).

Research has shown that the mineral and light conditions can enhance the nutritional content of these plants. Sprouts are concluded to be significant for the biodiversity and sustainable agriculture of microgreens (Rouphael et al., 2021). Microgreens are also recognized as a source of carotenoids, ascorbic acid, phylloquinone, γ-tocopherols, and phenolic compounds, in addition to macro and micronutrients. They contain a higher load of essential phytonutrients compared to mature vegetables. This dense phytochemical composition has attracted the attention of nutrition researchers and is becoming widespread among food technologists, urban farmers, and consumers. As public concern about the environmental and nutritional aspects of food production increases, consumers are shifting towards healthier and more environmentally friendly food products (Caracciolo et al., 2020).

Due to consumers' demand for healthy and environmentally friendly foods, interest in microgreens is growing. Therefore, it is emphasized that studies investigating the sensory properties of microgreens, their appearance, and their impact on consumer preferences are essential (Keutgen et al., 2021). According to a study by Bhaswant et al. (2023), the use of microgreens in foods is particularly widespread among chefs in luxury restaurants. The purposes of using microgreens include enhancing the visual appeal of food and attracting consumer interest. Moreover, consumer demand has increased, leading to their use in enriching nutritional content. Conscious consumption of microgreens is observed among vegetarian individuals due to their rich nutrient profile.

Restaurants place great importance on food quality and flavor. However, consumers have also shown significant interest in food decoration and healthy foods recently. Food decoration can effectively contribute to guest satisfaction. In developed countries, chefs aim to attract health-conscious consumers by using elements like microgreens, sprouts, and edible flowers to provide exotic flavors, colors, and appealing appearances in their dishes (Božić and Mašić, 2022). Regarding edible flowers, it is noted that in Turkish cuisine, foods and beverages prepared from various flowers hold a special place. The usage areas of some flowers in Turkish cuisine, including for foods, beverages, and spices, have been examined. Flowers are used not only in beverages such as tea, syrup, and sherbet, but also in dishes like soup, pilaf, stuffed grape leaves, pickles, and salads; as well as in sweets like jam, Turkish delight, and candies (Işık et al.,2017).

Microgreens are generally used to add intense flavor, vibrant colors, and crispy textures to salads. Because they contain beneficial phytochemicals at higher concentrations, microgreens are considered a functional food (Shibaeva et al., 2022). Many seed companies and producers in the United States offer a variety of microgreens. A study reported that there are 25 types of microgreens commercially available, which can add value to new food products (Choe et al., 2018). The ease of production and sufficient nutritional content of microgreens contribute to their growing popularity among people (Nayak et al., 2021).

In the last 20 years, increased public awareness of healthy eating has led to a rise in interest in fresh, functional, and healthy foods. This is seen as a positive development for microgreen growers, experts, and scientists to meet the opportunities related to these products. As interest in healthy eating, gourmet cooking, and indoor gardening increases in developed countries, the recognition of microgreens in these countries is also rising. They are generally used in small amounts as garnishes, toppings, or spices (Sharma et al., 2020).

One study indicates that restaurants and hotels in India are incorporating microgreens into their menus, with chefs creatively adding these small plants to their dishes. Due to their strong flavors, the demand for microgreens is increasing, and these foods are said to add a new dimension to dishes. Furthermore, microgreens, which have caught the attention of national media and press outlets, are now more frequently seen on chef plates and in supermarkets (Chatterjee and Joshi, 2020).

According to research by Renna et al. (2017), microgreens are typically used in “Fine Dining” restaurants, where they place significant importance on both the creative presentation and taste of their dishes. Home cooks attempt to replicate the “Fine Dining” restaurant experience at home by using microgreens. Compared to standard vegetables, most microgreens are said to have a flavor that is not “micro,” but rather strong and intense.

The leaves of microgreens can come in colors such as yellow, red, green, and purple. The attractive colors of the leaves, their wide shapes, and their diverse flavors positively influence their use in gastronomy (Hrițcu Maftei et al., 2018). Overall, microgreens are drawing attention as a research topic due to their rapid growth and ease of cultivation, becoming a focal point for chefs. They provide various flavor contributions and are gaining valuable recognition for their health benefits, becoming increasingly common in-home kitchens as well as by restaurant chefs (Lindell, 2023).

## CONCLUSION

Consumer dietary preferences have evolved significantly over time, with a growing interest in organic, gluten-free, and fermented foods, as well as sprouted and microgreen products. This shift in eating habits reflects an increased focus on healthy eating and specific dietary needs, driving greater demand for these food groups. The field of gastronomy is also adapting to meet consumers' needs through this innovative system. The use of microgreens in the kitchen is not only becoming common in businesses but is also making its way into home kitchens. Microgreens should be promoted in gastronomy for their flavor enhancement, visual aesthetics, nutritional value, dietary diversity, health benefits, and ease of production, particularly from a sustainability perspective. Their use should be emphasized not just in "Fine Dining" restaurants, but in accessible places for everyone. The effects of their bioactive compounds on human health should not be overlooked. Various promotional efforts should inform individuals about the use of microgreens and ensure they are aware of their benefits.

## ACKNOWLEDGEMENTS

None

## CONFLICT OF INTEREST

No conflict of interest was declared by the authors.

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