International Journal of Food Science and Nutrition
www.foodsciencejournal.com
ISSN: 2455-4898
Received: 28-05-2021, Accepted: 12-06-2021, Published: 28-06-2021
Volume 6, Issue 3, 2021, Page No. 113-119

A review article on microgreens as superfoods

Sneha S Bhat[1], Aditi Vichare[2]
[1] Student, Department of Nutraceuticals, Guru Nanak Khalsa College of Arts, Science and Commerce (Autonomous), Mumbai, India
[2] Professor, Department of Nutraceuticals, Guru Nanak Khalsa College of Arts, Science and Commerce (Autonomous), Mumbai, India

Abstract
Microgreens are an emerging specialty food product that is gaining popularity and attention these days. They are cotyledonary leafy greens that are young and fragile and come in a variety of hues, textures, and tastes. As a novel culinary element, they are gaining appeal. They are used to dress up salads or as edible garnishes on a range of different foods.
Due to their high quantity of purported benefits, microgreens have enormous potential for boosting the nutritional value of the human diet. microgreens are developed chiefly from mustard, cabbage, radish, buckwheat, lettuce, spinach. The utilization of microgreens has these days expanded because of higher centralizations of bioactive parts like nutrients, minerals, and cancer prevention agents than develop greens, which are significant for human wellbeing. Notwithstanding, they commonly have a short time span of usability because of fast item disintegration. This review is aimed to provide an overview of the nutritional facts, possible bioactive substances, and future prospects and challenges for broadening the probable markets.

Keywords: microgreens, bioactive, potential, nutritional facts, prospects

Introduction
A new era has begun in this world of nutrition that has enabled it to catch up with the advancing technology. Emerging technologies like nanotechnology or microarray have successfully increased the potential of nutrition. This has led to consumers having an access to knowledge of terms like superfoods, super herbs, and organic food. The term superfood is often defined as an intermediate between food and medicine because they need the elements of both. they're defined as that class of food that's the foremost potent, nutrient-concentrated, and nutrient-rich.
Super foods are an excellent choice if one aims for improving their overall health, boost the immune system in addition to cleansing and alkalizing the body. Since super foods are natural in origin, they strive to keep up a harmonic balance between the five elements of the human body: ether, water, air, fire, and earth in ways in which the scientists aren't ready to fully comprehend.
Plants still be a significant source of medication, as their need has been throughout human history. In light of the research ongoing on the advantages of varied phytochemicals in foods, it appears feasible that the naturally occurring chemical compounds may be helpful for the prevention or treatment of many chronic diseases.
Microgreens are a rapidly expanding market niche in industrialized nations, where chefs utilize tiny plants and plant pieces to add unique flavours, colours, and aesthetic presentation to dishes aimed at health-conscious, affluent customers [1]. They are edible vegetable and plant seedlings that have been picked fewer than 14 days after germination. Microgreens are normally nurtured under high light conditions with low mugginess and good ventilation. The seed thickness is a lot lower than sprouts. This might explain why microgreens have such a diverse flavour and taste profile. They have the potential to be classified as superfoods due to their high amount of vitamins and bioactive substances, and they are simple to cultivate at home in pots on a patio or windowsill.

Microgreens
When a seed is planted, it experiences numerous stages of growth one of them being the “microgreen stage”. This is often the stage at which the seed has grown into a little plant that is larger than a sprout but smaller than baby greens. They are normally collected at the base of their cotyledons, just after the cotyledons have emerged but before true leaves have formed [3].
Microgreens are classified as the sensitive sections of a vegetable, herb, or pulses and are slowly gaining recognition. They are a new horticultural food crop that has the potential to help fulfil the demands of changing surroundings while also generating high-nutrient meals that enhance human health [5]. Microgreens are gaining popularity among consumers, not only because of their well-known nutritional qualities but also because of their culinary potential [2] and their role in fulfilling the micro- nutritional content within the human body.Because of their many colours, flavours, and textures, microgreens have become popular as garnishes in restaurants and are commonly referred to as "vegetable confetti" or "confetti" [5]. Microgreens are an upmarket food source for highly demanding customers, such as vegetarians and vegans, who may diversify and enhance their diet by using the wide variety of microgreens available. Furthermore, because microgreens are typically taken uncooked, they will also meet the demands of so-called "raw foodists" [13]. Depending on the species, they vary in taste that may range from spicy to neutral and from slightly sour to bitter.

Table 1: Taxonomic families of common microgreens [14]

Family	Commonly grown microgreens
Alliaceae	chives, scallions, shallots, onions, garlic
Amaranthaceae	spinach, amaranth, beets, swiss chard, orach, and magenta spreen
Apiaceae	celery, cilantro, chervil, fennel, parsley, carrot, and dill
Asteraceae	lettuce, endive, sunflower, garland chrysanthemum, shungiku, tagetes (marigold)
Brassicaceae	mustards, cabbages, broccoli, cauliflower, radishes, tatsoi, wasabi, arugula, cresses, kohlrabi, mizuna, turnip, savoy, kale, komatsuna, pak choi, kogane, collard, nasturtium, Brussel sprouts, rapini, rutabaga
Cucurbitaceae	Cucumber
Lamiaceae	mint, basil, chia, and lemon balm
Oxalidaceae	wood sorrels, clover
Poaceae	corn, lemongrass
Polygonaceae	Buckwheat
Portulacaceae	claytonia, purslane
Fabaceae	sweet pea, alfalfa, fenugreek, adzuki, fava

Fig 1: Examples of varieties of microgreens [27].

Microgreens and Micronutrients

Micronutrients include vitamins and minerals that are necessary in minute quantities for sustaining appropriate metabolism, development, and well-being. Malnutrition and underdevelopment can come from a deficiency in any of the micronutrients. Due to high rates of disease and disability, micronutrient insufficiency, sometimes known as "hidden hunger," has an impact on health, learning ability, and productivity. It is a public health issue that affects more than a quarter of the world's population [4]. Microgreens, which nourish the body with essential nutrients in a minuscule percentage, can help bridge the gap between micronutrients

and deficiencies. As a result, they are being researched as space crops across the world.

Microgreens have up to 40 times the amount of important nutrients as their mature counterparts and are distinguished by a high concentration of carotenoids and chlorophylls, as well as organic acid, which contains no sugars and has anti-diabetic and anticholinergic properties [3].

The highest quantities of ascorbic acid, carotenoids, phylloquinone, and tocopherols are found in red cabbage, cilantro, garnet amaranth, and green daikon radish microgreens, with levels considerably greater in microgreens compared to database values for mature vegetable equivalents [6]. Microgreens belong to the family of Brassicaceae were found to be moderate to excellent sources of ascorbic acid, phylloquinone, carotenoids, tocopherols, glucosinolates, and polyphenols [7]. Brassica microgreens are rich providers of the macroelements K and Ca, as well as the microelements Fe and Zn, according to an analysis of 30 cultivars of Brassicaceae microgreens [9].

165 phenolic compounds were discovered in five microgreen cultivars of the genus Brassica, including several highly glycosylated and acylated quercetin, kaempferol, cyanidin aglycones, and complicated hydroxycinnamic and benzoic acids. Microgreens were shown to have more complex polyphenol profiles and a higher range of polyphenols than their mature plant counterparts [12]. Several antioxidant bioactive chemicals and minerals were assessed in broccoli, kale, mustard, and radish microgreens cultivated hydroponically. For ascorbic acid, total carotenoids, and total isothiocyanates, radish and mustard had the greatest bio accessible fraction (BF), whereas broccoli, kale, and radish all had equally high BF for total polyphenols [10].

Basil and swiss chard microgreens are high in K and Mg, and purple basil is particularly high in ascorbic acid, while green basil and coriander are particularly high in beta-carotene and total polyphenols [11].

Because bioactive components and antioxidant activity in mustard, radish, and cabbage microgreens are degraded quickly after harvest, microgreens must be consumed immediately after harvest to reap significant health advantages [12].

Microgreens in Cancer

The primary abnormality that leads to the development of cancer is the uncontrolled growth of cancer cells. Cancer cells proliferate and divide uncontrollably, infiltrating normal tissues and organs and eventually spreading throughout the body, rather than responding effectively to the signals that govern normal cell behaviour [15]. According to a study conducted, the 5 microgreens that have been considered as anti-cancer microgreens are:

a. Broccoli

Brassica vegetables rank first in terms of economic importance in world agriculture and markets. Because cruciferous vegetables are high in antioxidant bioactive substances such as tocopherols, polyphenols, and ascorbic acid, they must be connected to chronic disease prevention. In this regard, intake of Brassica greens has been linked to a lower risk of developing colorectal, stomach, pancreas, lung, breast, and ovarian cancer. [13]. Only a few species of brassica microgreens, particularly broccoli sprouts, mature broccoli, adult kale, mature mustard leaves, and the edible components (pod and flower) of radishes, can demonstrate antiproliferative effects on human colon cancer cell lines *in vitro*. Research on prostate cancer reported an 11-fold lower rate of invasive prostate cancer cells after feeding mice 15% broccoli microgreens in their diet for 12 weeks, and a further decrease to 2.4-fold after 28 weeks [16]. Hence we can conclude that although it does not completely cure cancer, it is significantly effective in slowing the progression of cancerous cells. A study also showed that including broccoli microgreen in the diet can prove to be effective in preventing the later development of breast cancer [17]. A study by a search group highlighted the very fact that total soluble polyphenols and total isothiocyanates were the most compounds accountable for the entire antioxidant capacity after digestion for broccoli, kale, mustard, and radish microgreens [13]. The antiproliferative effect of bio accessible fraction acted at several cellular levels through mechanisms (induction of phase II clinical trial enzymes, oxidative stress, autophagy, MAPK, and apoptosis) that are described for phytochemicals on human colon cancer.

b. Chickpea

Soy isoflavones present in chickpeas have been distinguished as dietary components having a significant role in lessening the frequency of breast and prostate cancers [18]. Genistein that is referred to as the most common phytoestrogen, has shown to bring about inactivation of NF-kappa B and Akt signalling pathways, both of which are supposed to bring out a homeostatic balance between cell survival and apoptosis. Furthermore, genistein has been found to have antioxidant properties and is shown to be a potent inhibitor of angiogenesis and metastasis [18].

c. Rutabaga

Rutabaga is a North American and a North European popular crop. The extracts of this crop (especially the 8-day sprout) showed positive results in inhibiting the tumour cell line. The findings strongly suggest that one of the biological activities of rutabaga is antiproliferative and proapoptotic potential specific to tumour cells by demonstrating antioxidant property [19]. Thus rutabaga sprouts can be regarded as a potential superfood for preventing cancer.

d. Flax Sprout

Flaxseeds, also called linseeds, show a good amount of phenolic compounds namely; phenolic acids, flavonoids, and lignin's that are well known for anticancer and anti-oxidative properties [20]. Research results suggest that flaxseed sprouts induce apoptosis and inhibit cancer cell growth, thereby demonstrating their anti-proliferative effects in breast cancer cells [21].

e. Tartary Buckwheat

This colourful microgreen is found in the Himalayan regions and is supposed to be rich in nutrients and gluten-free. TBWSP31 is a potential antitumor protein present in and apoptosis induced by TBWSP31 is a key antitumor mechanism [22]. An analysis of the cell cycle showed that TBWSP31 arrests the cell in G_0/G_1 phase, thereby preventing the cells from cycling into the S phase.

Microgreens in Neurodegenerative Disease

Sulforaphane is an isothiocyanate found naturally in

cruciferous plants like broccoli, brussels sprouts, and kale. It is formed when the enzyme myrosinase catalyzes the breakdown of glucoraphanin in response to stress **[23].** Sulforaphane's neuroprotective properties are linked to the Nrf2 pathway. This pathway includes pathological events like neuroinflammation, oxidative stress, mitochondrial dysfunction, excitotoxicity, and neuronal damage that occur in neurodegenerative diseases. Since no successful remedies have yet been found, people are indeed relying on natural defenses, the first being the consumption of sulforaphane in Broccoli microgreens.

a. Alzheimer's Disease

Alzheimer's disease (AD) is a chronic neurodegenerative disease that causes progressive cognitive deficits. Extracellular aggregates of beta-amyloid (Aβ) peptides lead to plaque formation and intracellular accumulation of hyperphosphorylated tau protein, which causes the formation of neurofibrillary tangles in the condition. Studies have explored the impacts of SFN in PS1V97L transgenic mice. It was reported that SFN inhibited A aggregation, tau hyperphosphorylation, oxidative stress (as determined by GSH and MDA levels), and neuroinflammation (as quantified by TNF- and IL-1 levels) [31]. As a result, the findings of the study revealed that SFN could be used to prevent Aβ accumulation in Alzheimer's disease.

b. Parkinson's Disease

Parkinson's disease (PD) is a neurodegenerative condition that causes cognitive and motor deficits. Pretreatment of SNF to PD-induced models showed a reversal in the reduction of HO-1 (Heme oxygenase-1) and NQO-1 expression that are usually present in high levels in the brain of PD patients. SFN did exert this defensive effect, most likely by upregulation of the Nrf2-ARE pathway [24].

c. Multiple Sclerosis

Multiple sclerosis (MP) is a demyelinating, autoimmune neurodegenerative disease that primarily affects women. The Nrf2/ARE signaling system, which acts as a modulator of antioxidant and phase II detoxification genes, has shown to be a promising therapeutic goal for MS [25]. As a result, by modulating the antioxidant response, SFN can be effective in combating the adverse outcomes that characterize MS, such as oxidative stress and neuroinflammation.

Microgreens in Cardiovascular Health

Polyphenols, a form of antioxidant found in microgreens, have been linked to a reduction in the risk of heart disease. Microgreens have been shown in studies to help reduce triglycerides and LDL cholesterol levels. Certain varieties of microgreens are also high in sulforaphane, a compound that helps to reduce systemic inflammation and protects against cardiovascular disease. There are a variety of varieties of microgreens that are particularly effective for heart health if one wants to boost their nutritional benefits:

a. Broccoli

Sulforaphane levels in broccoli microgreens are higher than in virtually any other food. Although it can be present in other vegetables such as cauliflower and cabbage, broccoli sprouts have a high concentration of it. Sulforaphane protects humans from a variety of cancers, diabetes, Alzheimer's disease, and cardiovascular disease, in addition to reducing chronic inflammation.

b. Basil

Basil microgreens, also known as micro basil, have a greater concentration of polyphenols. Polyphenols have significant antioxidant effects, which ensure that they help the body strip itself of free radicals before they build up to toxic levels. They help to reduce systemic inflammation, which is a primary cause of heart disease. Polyphenols can also be found in mature vegetables, but microgreens have a relatively high concentration and diversity.

c. Chia Greens

Chia seeds have risen in popularity in recent years as a nutritious food high in omega-3 fatty acids, the same good fat present in salmon. Chia seeds, on the other hand, can be used to sprout chia microgreens, which have the same omega-3 fatty acids like chia seeds. Chia greens are easy to cultivate and have a tangy taste that makes them a great addition to sandwiches and salads. More particularly, they are high in omega-3 fatty acids, which are excellent for cardiovascular wellbeing.

d. Sunflower Shoots

Sunflower shoots are another kind of microgreen that is good for the heart. These crunchy sprouted leaves, developed from sunflower seeds, are rich in folate, selenium, vitamins C and E, and B complex vitamins. They're also rich in essential amino acids, which are very beneficial for the human heart.

Nutritional Facts about Microgreens

- They are high in vitamin C. Vitamin C, an antioxidant that helps protect the body from the harmful effects of free radicals is abundant in young edible seedlings. Even the microgreen sample with the lowest amounts of vitamin C contained a whopping 20 milligrams of vitamin C per 100 grams, which is almost twice the amount of vitamin C present in tomatoes, according to a 2012 review. Of the checked types, red cabbage microgreens provided the highest levels of vitamin C, with a 100-gram section containing 147 milligrams – or 245 percent of the daily dose – of this essential nutrient. In addition, according to USDA reports, an equal-sized serving of mature raw red cabbage provides 57 milligrams of vitamin C.
- Beta-Carotene is abundant in many microgreens. Carotenoids, including beta-carotene, are thought to reduce the risk of disease, particularly cancer and eye disease. Beta-carotene is often associated with carrots, but microgreens are also high in this essential nutrient. According to a 2012 report, some microgreens tend to possess much more beta-carotene than carrots, with 12 milligrams per 100 grams compared to 8 milligrams in boiled carrots. Researchers who looked at the beta-carotene content of microgreens discovered that they also contain other carotenoids such as lutein and zeaxanthin.
- They are a good source of Vitamin E. Yale University scientists discovered that young pea seedlings grown in light possess large amounts of tocopherol in 1967. Similarly, the researchers behind the 2012 microgreen analysis discovered significant concentrations of

tocopherols in the greens they studied. The total volume of alpha-tocopherol and gamma-tocopherol in these microgreens ranged from 7.9 to 126.8 milligrams per 100 grams, with green daikon radish microgreens having the highest value. The regular requirement for vitamin E for adults is 15 milligrams of alpha-tocopherol.

- Greens contain Vitamin K, even if they are small. The Yale thesis on pea microgreens – or young pea seedlings as they were known back then – also discovered that when the seedlings were exposed to light, they began to release significant quantities of vitamin K. When chlorophyll – found in all green plants, including microgreens – consumes sunlight to generate carbohydrates and oxygen during photosynthesis, vitamin K acts as an electron acceptor. Humans benefit from vitamin K because it promotes proper blood clotting and prevents unnecessary bleeding.

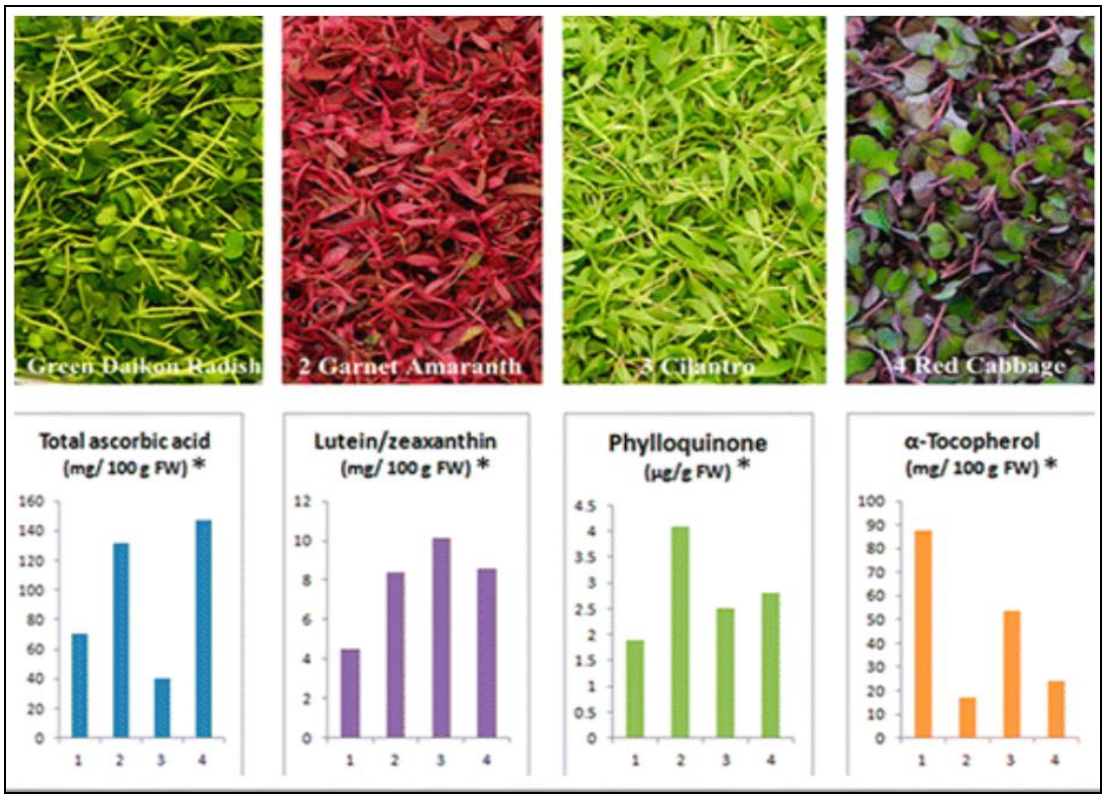

Fig 2: The first scientific analysis of nutrient levels in edible microgreens has found that many of those trendy seedlings of green vegetables and herbs have more vitamins and healthful nutrients than their fully-grown counterparts. A report on the research appears in ACS' *Journal of Agricultural and Food Chemistry* [26].

Incorporating Microgreens in the Diet

Microgreens, being tasty tiny morsels, are highly adaptable and may be utilized in a variety of ways.

a. Salads

When eaten raw, all microgreens shine. By avoiding the burner, one can not only keep them fresh and crisp but also retain the delicate flavor character that you expect from each of these little powerhouses. Because various microgreens have such distinct flavor profiles, they may be mixed to create salads with a light and spicy flavor, or to blast the taste receptors with a sweet or moderate punch.

In addition to the fact that any heating process reduces some of the nutrients, one has got a lot of reasons to go the raw food route when it comes to microgreens. Sunflower shoots are one green that does very well when left uncooked. This citrus green is a great way to brighten up salads.

b. Sandwiches and Wraps

Microgreens are a fantastic way to add a punch of flavor and nutrients to any sandwich or wrap, whether it's a tortilla, pita, or gluten-free. Radish greens are particularly fascinating for this since they also add a spicy aspect to the meal. Microgreens have a mild taste and freshness that balances out earthier flavors and adds nutritious benefits. Using microgreens in sandwiches might also be beneficial due to the increased crunch of texture.

c. Juices and Smoothies

When it comes to the world of juices, wheatgrass is the undisputed champion. Wheatgrass has long been used by individuals seeking maximum health through juicing. Many people find that adding this to a variety of other items helps reduce the extremely green flavor while also providing a really rich nutrition boost.

However further studies and clinical trials need to be carried out to detect the nutritional content of microgreens when incorporated into the diet.

Challenges

The rising demand for "superfoods" such as microgreens may present an opportunity for the Indian food business. More people are becoming aware of microgreens as a result of the creation of separate categories for greens.

Microgreens have a high price market and a dependable client sector (culinary and fancy restaurants), and their high

price market is a result of expensive production expenses and obstacles to maintain them contamination-free throughout all phases, beginning with medium preparation and ending with correct packing. Microgreens, on the other hand, have a low yield, fast senescence, and very limited shelf life, which limits their commercial production [28, 29].

Due to the COVID pandemic, the majority of microgreen production is now domestic and is predicted to slow organic crop demand growth owing to a decrease in discretionary expenditure [30].

Conclusion

Through this review article, it can be inferred that the concentrations of vitamins, minerals, and carotenoids in microgreens are greater than in fully grown equivalents. One may also think of them as a new, prospective food source that can be added to the diet because of their health quotient.

Microgreens should be harvested during the first true leaf stage of plant development when seedlings are about 2 inches tall. Microgreens are a new type of claim-to-fame crop that has gained popularity in the last decade due to their nutritional and organoleptic properties. The types of crops chosen for production and sale as microgreens have an advantage in terms of color (such as red or purple), texture, or flavor. Indeed, microgreens are sometimes marketed as "sweet," "mellow," "bright," or "hot" intensity mixes.

Cultivating microgreens can provide networks with increased food security and allow individuals to be more self-sufficient in their homes. Microgreens are excellent yields for urban farming in small spaces since they can be grown in almost any environment with few resources.

Microgreens can be grown quickly and are currently gaining popularity among customers who, more than ever before, are seeking nearby sustainable food sources.

References

1. Renna M, Stellacci AM, Corbo F, Santamaria, P. The Use of a Nutrient Quality Score is Effective to Assess the Overall Nutritional Value of Three Brassica Microgreens. Foods (Basel, Switzerland),2020:9(9):1226. https://doi.org/10.3390/foods9091226.
2. Wojdyło A, Nowicka P, Tkacz K, Turkiewicz IP. Sprouts vs. Microgreens as Novel Functional Foods: Variation of Nutritional and Phytochemical Profiles and Their *In vitro* Bioactive Properties. Molecules (Basel, Switzerland):2020:25(20):4648. https://doi.org/10.3390/molecules25204648.
3. Gonmei Z, Toteja GS. Micronutrient status of Indian population. The Indian journal of medical research,2018:148(5):511-521. https://doi.org/10.4103/ijmr.IJMR_1768_18.
4. Johnson SA, Prenni JE, Heuberger AL, Isweiri H, Chaparro JM, Newman SE. *et al*. Comprehensive Evaluation of Metabolites and Minerals in 6 Microgreen Species and the Influence of Maturity. Current developments in nutrition,2020:5(2):180. https://doi.org/10.1093/cdn/nzaa180.
5. Xiao Z, Lester G, Luo Y, Wang Q. Assessment of Vitamin and Carotenoid Concentrations of Emerging Food Products: Edible Microgreens. Journal Of Agricultural And Food Chemistry,2012:60(31):7644-7651. https://doi.org/10.1021/jf300459b.
6. Xiao Z, Rausch S, Luo Y, Sun J, Yu L, Wang Q. *et al*. Microgreens of Brassicaceae: Genetic diversity of phytochemical concentrations and antioxidant capacity, 2021.
7. Zhenlei Xiao, Eton E Codling, Yaguang Luo, Xiangwu Nou, Gene E Lester, Qin Wang. *et al*. Microgreens of Brassicaceae: Mineral composition and content of 30 varieties, Journal of Food Composition and Analysis,2016:49:87-93.
8. De la Fuente B, López-García G, Mañez V, Alegría A, Barberá R, Cilla, A. *et al*. Evaluation of the Bioaccessibility of Antioxidant Bioactive Compounds and Minerals of Four Genotypes of Brassicaceae Microgreens. Foods,2019:8(7):250. MDPI AG. Retrieved from http://dx.doi.org/10.3390/foods8070250
9. Kyriacou MC, El-Nakhel C, Graziani G, Pannico A, Soteriou GA, Giordano M. *et al*. Functional quality in novel food sources: Genotypic variation in the nutritive and phytochemical composition of thirteen microgreens species. Food chemistry, 277, 107–118. https://doi.org/10.1016/j.foodchem.2018.10.098.
10. Donato F Romagnolo, Micah G Donovan, Andreas J Papoutsis, Tom C Doetschman, Ornella I Selmin, Genistein Prevents BRCA1 CpG Methylation and Proliferation in Human Breast Cancer Cells with Activated Aromatic Hydrocarbon Receptor, Current Developments in Nutrition, Volume 1, Issue 6, June 2017, e000562, https://doi.org/10.3945/cdn.117.000562.
11. Sun, J., Xiao, Z., Lin, L. Z., Lester, G. E., Wang, Q., Harnly, J. M., & Chen, P. (2013). Profiling polyphenols in five Brassica species microgreens by UHPLC-PDA-ESI/HRMS(n.). *Journal of agricultural and food chemistry*, *61*(46), 10960–10970. https://doi.org/10.1021/jf401802n
12. Renna, M., Castellino, M., Leoni, B., Paradiso, V. M., & Santamaria, P. (2018). Microgreens Production with Low Potassium Content for Patients with Impaired Kidney Function. *Nutrients*, *10*(6), 675. https://doi.org/10.3390/nu10060675
13. Fuente, B., López-García, G., Máñez, V., Alegría, A., Barberá, R., & Cilla, A. (2020). Antiproliferative Effect of Bioaccessible Fractions of Four *Brassicaceae* Microgreens on Human Colon Cancer Cells Linked to Their Phytochemical Composition. *Antioxidants (Basel, Switzerland)*, *9*(5), 368. https://doi.org/10.3390/antiox9050368.
14. Turner, E., Luo, Y., & Buchanan, R. (2020). Microgreen nutrition, food safety, and shelf life: A review. *Journal Of Food Science*, *85*(4), 870-882. https://doi.org/10.1111/1750-3841.15049.
15. Cooper GM. The Cell: A Molecular Approach. 2nd edition. Sunderland (MA): Sinauer Associates; 2000. The Development and Causes of Cancer. Available from: https://www.ncbi.nlm.nih.gov/books/NBK9963/.
16. Beaver, L. M., Löhr, C. V., Clarke, J. D., Glasser, S. T., Watson, G. W., Wong, C. P., Zhang, Z., Williams, D. E., Dashwood, R. H., Shannon, J., Thuillier, P., & Ho, E. (2017). Broccoli Sprouts Delay Prostate Cancer Formation and Decrease Prostate Cancer Severity with a Concurrent Decrease in HDAC3 Protein Expression in Transgenic Adenocarcinoma of the Mouse Prostate (TRAMP) Mice. Current developments in

nutrition,2019:2(3):2. https://doi.org/10.1093/cdn/nzy002.
17. Li Y, Buckhaults P, Li S, Tollefsbol T. Temporal Efficacy of a Sulforaphane-Based Broccoli Sprout Diet in Prevention of Breast Cancer through Modulation of Epigenetic Mechanisms. Cancer prevention research (Philadelphia, Pa.),2018:11(8):451-464. https://doi.org/10.1158/1940-6207.CAPR-17-0423.
18. Sarkar F, Li Y. Soy Isoflavones and Cancer Prevention. Cancer Investigation, 2003:21(5):744-757. https://doi.org/10.1081/cnv-120023773.
19. Pasko P, Bukowska-Strakova K, Gdula-Argasinska J, Tyszka-Czochara M. Rutabaga (Brassica napus L. var. napobrassica) seeds, roots, and sprouts: a novel kind of food with antioxidant properties and proapoptotic potential in Hep G2 hepatoma cell line. Journal of medicinal food,2013:16(8):749-759. https://doi.org/10.1089/jmf.2012.0250.
20. Kajla P, Sharma A, Sood DR. Flaxseed-a potential functional food source. Journal of food science and technology,2015:52(4):1857-1871. https://doi.org/10.1007/s13197-014-1293-y.
21. Lee J, Cho K. Flaxseed sprouts induce apoptosis and inhibit growth in MCF-7 and MDA-MB-231 human breast cancer cells. *In vitro* Cell. Dev. Biol.-Animal,2012:48:244-250. https://doi.org/10.1007/s11626-012-9492-.
22. Guo X, Zhu K, Zhang H, Yao H. Anti-tumour activity of a novel protein obtained from Tartary buckwheat. International journal of molecular sciences,2010:11(12):5201-5211. https://doi.org/10.3390/ijms11125201.
23. Alzdiscovery.org, 2021. Retrieved 22 May 2021, from https://www.alzdiscovery.org/uploads/cognitive_vitality_media/Sulforaphane-Cognitive-Vitality-For-Researchers.pdf.
24. Schepici G, Bramanti P, Mazzon E. Efficacy of Sulforaphane in Neurodegenerative Diseases. International journal of molecular sciences, 2020:21(22):8637. https://doi.org/10.3390/ijms21228637.
25. Michaličková D, Hrnčíř T, Canová N, Slanař O. Targeting Keap1/Nrf2/ARE signalling pathway in multiple sclerosis. European Journal Of Pharmacology,2020:873,172973. https://doi.org/10.1016/j.ejphar.2020.172973.
26. *Many trendy 'microgreens' are more nutritious than their mature counterparts*. Phys.org, 2021. Retrieved 25 May 2021, from https://phys.org/news/2012-08-trendy-microgreens-nutritious-mature-counterparts.html.
27. *What are Microgreens?*. ALABAMA MICROGREENS. (2021). Retrieved 25 May 2021, from https://www.alabamamicrogreens.com/what-are-microgreens.html.
28. Chandra D, Kim JG, Kim YP. Changes in microbial population and quality of microgreens treated with different sanitizers and packaging films. Horticulture Environment and Biotechnology,2012:53(1):32-40. https://doi.org/10.1007/s13580-012-0075-6.
29. Kou L, Luo Y, Yang T, Xiao Z, Turner ER, Lester GE. *et al*. Postharvest biology, quality and shelf life of buckwheat microgreens. LWT - Food Science and Technology,2013:51(1):73-78. https://doi.org/10.1016/j.lwt.2012.11.017.
30. Grooms D. Microgreens: Market Analysis, Growing Methods and Models, 2020.
31. Hou Ting-Ting, *et al*. "Sulforaphane Inhibits the Generation of Amyloid-β Oligomer and Promotes Spatial Learning and Memory in Alzheimer's Disease (PS1V97L) Transgenic Mice." Journal of Alzheimer's Disease, 2018:62(4):1803-13. DOI.org (Crossref), doi:10.3233/JAD-171110.