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"Pre-microgreens:The New Super food"

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Introduction: The ever-burgeoning global urban population is placing high demand on sustainable, accessible and nutrient-rich food sources. The shrinking agricultural land, the demand for nutrient-dense, antioxidant abundant and space-efficient crops like pre-microgreens has risen substantially. These pre-microgreens have a short growth cycle, occupy minimal space and are nutritionally abundant make them an ideal solution for sustainable urban farming and future micronutrient security.Their immaturity helps keep the concentration of nutrients rather than allowing them to become diluted over time as they mature.

So, there is an increased interest in the consumption of sprouts and pre-microgreens.Pre-microgreens offer a wide range of nutrients and health-promoting effects as they contain health-enhancing phytonutrients like antioxidants, vitamins, minerals, phenolic compounds and other beneficial substances which are 40 to 45 higher and regarded as the next generation of "superfoods" or "functional foods".

Defining pre-microgreens: Pre-microgreens are the germination stage where visible differentiation of root (radicle) and shoot (plumule) is not there and before development of cotyledonary leaves.

Premicrogreens differ from sprouts and microgreens as sprouts develop a radicle and may sometimes have a small shoot. In contrast, microgreens are young seedlings harvested after the cotyledonary leaves have developed and they have mild flavour. A sprout includes the seed, root, and stem whereas microgreens are harvested, excluding the roots.

Nutritional composition of pre-microgreens:Several studies have investigated the rich presence of bioactive compounds in pre-microgreens such as vitamins, minerals and phytochemicals. Special attention has been given to antioxidantsthat neutralise the free radicals and reduce oxidative stress damage. These include vitamin C and phytochemicals like carotenoids and phenolics and essential minerals such as copper, zinc and selenium.

Studies conducted on 25 varieties of premicrogreens showed a wide variation in phylloquinone content ranging from 0.6 to 4.1 µg/g fresh weight. Varieties with green or bright red pigmentation exhibited higher phylloquinone levels (2.8–4.1 µg/g) while yellow-coloured ones contained relatively lower amounts (0.7–0.9

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µg/g). Overall, premicrogreens displayed considerably greater phylloquinone concentrations than their mature forms.

In another study evaluating 25 different microgreen varieties, total ascorbic acid, free ascorbic acid, and dehydroascorbic acid were quantified. The total ascorbic acid content among these microgreens varied between 20.4 and 147.0 mg per 100 g fresh weight.

In a study, the vitamin C contents in 9 microgreens were measuredand found to be higher in jute and cucumber microgreens, which had higher VC (25 mg/100 g fresh weight and 34.90 mg/100 g FW)

Some research studies have shown that green daikon radish microgreens contained the highest levels of α-tocopherol (87.4 mg/100 g) and γ-tocopherol (39.4 mg/100 g).

Analysis of 25 microgreen varieties revealed a broad range of β-carotene concentrations. Red sorrel exhibited the highest level at 12.1 mg/100 g fresh weight, while golden pea tendrils and popcorn shoots contained the lowest amounts (0.6 mg/100 g).

Some studies have shown that microgreens are excellent sources of minerals.A study that examined the nutritional composition of three Brassica microgreens—cauliflower, broccoli, and broccoli raberevealed that all three species are abundant in essential mineral elements, including Na, Cu, Mn, Ca, Mg, K, Zn, and Fe.

In addition to these minerals, the microgreens were also rich in key macronutrients such as proteins, dietary fibres, α-tocopherol, β-carotene and other beneficial compounds.

Benefits of Pre-microgreens:In recent years, due to rapid lifestyle changes and unhealthy dietary habits, reduced physical activity, increased stress levels, and sedentary work routinesit has led to a significant rise in metabolic disorders. Conditions such as obesity, type 2 diabetes, cardiovascular diseases and hypertension are increasingly prevalent across all age groups. Bioactive compounds can modulate many inflammation-related pathways.

Pre-microgreens are rich in bioactive compounds.Microgreens are rich in polyphenols and flavonoids, which reduce oxidative stress, protect the beta cells, and reduce inflammation. They also provide high fibre, which reduces obesity, diabetes and cardiovascular diseases. They regulate the blood pressure by providing minerals like potassium and magnesium.

It is also believed that inflammation can contribute significantly to the process of carcinogenesis. Pre-

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microgreens particularly those derived from Brassica vegetables have high amount of precursors of indoles and other compounds that stimulate xenobiotic metabolism. Therefore,pre-microgreens may help regulate or inhibit the progression of breast and prostate cancers by modulating sex-steroid hormone-dependent pathways.

Studies have shown that flavonoids such as kaempferol, quercetin, and apigenin are the key compounds that regulate the gut microbiota and cocoa-derived flavonoids enhance the population of beneficial gut bacteria like bifidobacteria and lactobacilli, which have plasma triacylglycerol-lowering effects.The gut microbiota can also metabolise phytochemicals into bioactive compounds, which have health-promoting properties, including anti-inflammatory effects. Sincepre-microgreens are abundant in flavonoids, their consumption may positively influence gut microbiome that is linked from mental health to longevity.Pre-microgreens can be considered as prebiotics as they are rich in dietary fibre that feeds the beneficial bacteria in the gut. These bacteria play a vital role in maintaining a healthy gut and immune system. By consuming pre-microgreens regularly, the growth of these beneficial bacteria is supportedto protect gut health.

Pre-microgreens are best consumed fresh to retain their full nutritional value and delicate flavours. They can be included in daily diets as base or topping for salads, sprinkle over soups, sandwiches, pizzas, and main courses, blend a handful into smoothies or mix into wraps, tacos or omelettes for added texture and nutrients.

Pre-microgreens are produced using seeds belonging to family of –

Brassicaceae **:** Cauliflower, broccoli, cabbage, watercress and radish

Asteraceae **:** Lettuces and chicory

Apiaceae **:** Dill, carrot, fennel and celery

Amaryllidaceae **:** Garlic, onion and leek

Amaranthaceae **:** Amaranthus, quinoa, beets and spinach

Cucurbitaceae **:** Melon, cucumber and squash

Cereals like rice, oats, wheat, corn and barley as well as legumes like chickpeas, beans and lentils are also used to grow pre-microgreens.

Precautions to be taken while growing pre-microgreens: Good-quality seeds, proper growing medium like container filled with potting soil or homemade compost or alternatively single-use growing mat specifically designed for growing pre-microgreens can be used. Ther should be proper lighting either sunlight or ultraviolet lighting, ideally for 12–16 hours per day.

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