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Nutraceutical potential of non-leafy vegetable waste in Punjab

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Abstract
Vegetables play a pivotal role in the daily lives of individuals, particularly those in the working sector who prioritize nutrient-rich and convenient food options. Vegetable soups emerge as an excellent reservoir of essential nutrients required for optimal development, growth, acid-base balance maintenance, and various bodily functions. The components encompassed within vegetable soups and plant extracts, such as minerals, dietary fiber, antioxidants, fatty acids, vitamins, and amino acids, stand as vital constituents crucial for both physical and mental well-being. These soups, available in diverse traditional variations, hold a significant position as a staple food for billions worldwide, sought after for their nutritional and health advantages. They often serve as a prelude to meals, rapidly providing nourishment while curbing hunger and supporting gastrointestinal responses. This analysis primarily delves into the nutraceutical attributes of by-products arising from food processing. These by-products encompass vegetable peels, seeds, leaves, and similar components derived from various sources within the food industry. The surplus generated from households and food-related industries is collected and harnessed by extracting essential nutrients. This practice not only reduces waste but also maximizes the utilization of these otherwise discarded components, transforming them into valuable sources of nutraceutical benefits.

Keywords: Nutraceutical potential, non-leafy vegetable

Introduction
Vegetables play a pivotal role in the daily lives of individuals, particularly those in the working sector who prioritize nutrient-rich and convenient food options. Vegetable soups emerge as an excellent reservoir of essential nutrients required for optimal development, growth, acid-base balance maintenance, and various bodily functions. The components encompassed within vegetable soups and plant extracts, such as minerals, dietary fiber, antioxidants, fatty acids, vitamins, and amino acids, stand as vital constituents crucial for both physical and mental well-being. These soups, available in diverse traditional variations, hold a significant position as a staple food for billions worldwide, sought after for their nutritional and health advantages. They often serve as a prelude to meals, rapidly providing nourishment while curbing hunger and supporting gastrointestinal responses. This analysis primarily delves into the nutraceutical attributes of by-products arising from food processing. These by-products encompass vegetable peels, seeds, leaves, and similar components derived from various sources within the food industry. The surplus generated from households and food-related industries is collected and harnessed by extracting essential nutrients. This practice not only reduces waste but also maximizes the utilization of these otherwise discarded components, transforming them into valuable sources of nutraceutical benefits.

Introduction
The nutritional significance of vegetables cannot be overstated, as they serve as substantial reservoirs of essential nutrients including vitamins, minerals, dietary fiber, phytochemicals, antioxidants, and other health-promoting compounds. In the modern era, with an increased emphasis on health and well-being, a diverse range of vegetables is incorporated into daily diets, leading to the generation of biodegradable agricultural waste. This waste predominantly consists of skin, stem, peel, rind, seed, shell, and pomace. Many of these discarded components possess the potential to be utilized as natural and renewable resources, termed as bio resources. These bio resources encompass non-fossil biological materials that can be harnessed for the creation of various goods and services, spanning from commodities to energy sources, such as carbohydrates in potatoes, wood, grains, and algae.

On the other hand, several initiatives and frameworks are dedicated to the management and sustainable development of these bio resources, with institutions like the Institute of bio resources and Sustainable Development (IBSD) in Imphal being notable examples. The significance of fruits and vegetables in promoting optimal health and ensuring access to nourishing sustenance cannot be disregarded. (P. Gupta *et al*., 2021) [14]

Vegetable intake in a typical Punjabi rural family is much lower than the ICMR's (Indian Council of Medical Research) recommendations (Kaur *et al*. 2005) [38]. Given the declining trend in the production of vegetable crops for domestic consumption, these disturbing findings are cause for concern. Vegetable crops grown at the home level not only help to boost food intake in terms of quantity and quality, but they also help to decrease the space used for paddy wheat rotation and lower household costs. There is no contradiction with food grain self-sufficiency due to the type and quantity of crop diversification. Several actions were made to increase the area devoted to vegetable growing, both at the planning and execution levels, but more must be taken to meet the goals. The current study was therefore created to profile several elements of vegetable growers in Punjab, where in the year 2005-2006 the total production was 2.47 million tons from an area of 1.63 lakh hectares with a productivity of 15.1 tons per hectare (Sidhu *et al*., 2010) [42]. Regarding potatoes, the Jalandhar market has a good level of integration with a few other Punjabi markets. The prices of potatoes in all the state's chosen markets, however, were affected solely in one way by the national market (New Delhi). Tomato prices were influenced by the New Delhi market in all the chosen state markets unidirectionally, apart from the Amritsar market, where there was a two-way price relationship. The Amritsar market was well integrated with other chosen markets of Punjab in this case (Mohapatra, 2021) [30] (Al-saikhan & Miller, 195 C.E.) [2].

Produced in enormous quantities in fields, farms, marketplaces, and processing industry sites, fruits, vegetables, dairy products, and other food processing wastes cause major destruction when disposed of because of their high rate of biodegradation. Around the world, utilizing waste from the food processing industry is a particularly important and difficult undertaking. Agri-horticultural wastes are a rich source of valuable phytochemicals and nutrients, which studies have shown can be used to make nutraceuticals and functional foods. They are also abundant in additional secondary metabolites that have the potential as adjuvants in the treatment of several medical conditions, including aging, hypertension, cancer, cardiovascular, and other degenerative illnesses (C. Gupta, 2017) [13]

Nutraceuticals are therapeutic foods that contribute to bettering health, preserving happiness, boosting immunity, and so avoiding as well as treating diseases. Phytochemicals play specialized roles, can be employed in a variety of ways, such as antioxidants, and are beneficial to human health. Phytochemicals with cancer-preventive qualities have received a lot of interest recently (Lozano-Sánchez *et al*., 2017) [25]. A developing trend in the food market today is the creation and production of functional and nutraceutical products. Due to growing customer interest in "healthy" eating, this new class of food products has attracted a lot of attention in the food industry (Filip *et al*., 2017) [10] (Lozano-Sánchez *et al*., 2017) [25].

Concluding that vegetable is an important source of vitamins, minerals, phytochemicals, antioxidants, and other healthy substances. Due to their importance, they are consumed every day, and as a result, it produces biodegradable agricultural waste for example skin, peel, seed, rind, shell, etc. There is certain bioresource management and sustainable devolvement for waste management. Due to the lack attention of to growing vegetables in Punjab, several actions were made to increase the area devoted to vegetable growing. In the year 2005-2006, the total production was 2.47 million tons from an area of 1.63 lakh hectares. Agri-horticultural wastes are a rich source of phytochemical nutrients. Nutraceuticals are therapeutic food that contributes to better health as well as treats various diseases. Nutraceutical products act a major role in the marketing area due to the growing customer interest in healthy eating.

Literatures

Kumar *et al*. (2020) [22] and others have gone through Polysaccharide proteins, fibers, flavorings, and phytochemicals that have been extracted from food industry waste and by-products that can be used as nutraceuticals as well as ingredients in the creation of functional meals. Alternatively stated, a nutraceutical can be any item with known nutritional benefits, such as vitamins, minerals, different types of amino acids, and fatty acids in the form of dietary supplements made from certain ingredients derived from other sources. The bioactive ingredients that can be isolated from food by-products have a lot of potential for application in the production of functional foods, biotechnological preparations, and pharmaceutical goods. The methods for extracting bioactive substances need to be improved by science and business on a wider scale to make them more commercially viable. (Kumar *et al*., 2017) [23] (Kumar, 2020) [22].

Kumar *et al*. (2017) [23] authors have covered a thorough analysis of numerous methods for bioactive component extraction in this review. Additionally, their effective use in the creation of nutraceutical products, health advantages, the development of bioprocesses, and the addition of value to resources made from food waste. Food and agricultural waste are becoming more readily available due to the expansion of food processing industries and post-harvest losses of fruits and vegetables. Using this waste as a source of bioactive compounds, will improve farmers' financial standing and lessen the burden of waste management. A sustainable bioprocess will greatly benefit from advancements in extraction technology that require little or no solvent (Kumar *et al*., 2017) [23].

Author Rudra *et al*. (2015) [38] have gone through the target food industry waste: mine of nutraceuticals The goal of this review is to compile research on the waste treatment from fruits, vegetables, cereals, pulses, coffee, and arable crops for the manufacture of usable ingredients. Case studies of four of the most popular individual fruits—apple, mango, pineapple, and grapes—will then be presented. Fruit and vegetable processing waste products including peels, seeds, and stones can be successfully employed as a source of phytochemicals and antioxidants. The by-products are a valuable source of sugars, minerals, organic acids, dietary fiber, and phenolics, which have a variety of actions, including anti-tumor, antiviral, antibacterial, cardioprotective, and antimutagenic properties (Rudra *et al*., 2015) [38].

Charu Gupta *et al*. (2017) [13] have gone through the nutraceutical potential of Agri horticultural waste. This

review focused on utilizing waste from the food processing industry, which is a very important and difficult undertaking. According to studies, agricultural wastes are a rich source of valuable phytochemicals and nutrients that might be used to make nutraceuticals and functional foods. Utilizing the waste material could significantly improve the food processing chains' economic performance and reduce disposal issues. It is crucial to encourage the use of more fruit and vegetable waste to produce by-products with useful qualities and health advantages. As a result, food producers should also make investments in niche secondary industries to make use of Agri-horticultural residues. To reduce, recycle, and reuse waste, efforts must be made to develop new technologies. This is only possible if food leftovers are viewed as complementary resources rather than as unwanted wastes (Prakash, n.d.).

Target

This review centers on exploring the nutraceutical potential inherent in no leafy vegetables. Within the context of a busy working individual's daily life, vegetables take on a crucial role. Nutraceuticals, often referred to as therapeutic foods, play a pivotal role in enhancing health, preserving well-being, bolstering immune function, and mitigating the onset and progression of diseases. Among the valuable constituents within vegetables, phytochemicals stand out, serving specialized functions, particularly as antioxidants, and exhibiting favorable impacts on human health. Phytochemicals that possess cancer-preventive attributes have garnered significant attention in recent times (Lozano-Sánchez *et al*., 2017) [25]. A creeping vine known as a cucumber (*Cucumis sativus*) produces cylinder-shaped fruits, a member of the Cucurbitaceae family of gourds (Niyi *et al*., 2019) [31]. Focusing on specific vegetables, cucumber, for instance, showcases noteworthy nutraceutical potential with its composition of Carbohydrates at 2.9 g, Protein at 7.0 g per 10 g, Fibre at 23.0 g per 100 mg, Iron at 7.39 g, Potassium at 0.01 g, Calcium at 2.62 g, and Ash at 7.85 g per 100 g. Furthermore, it contains a total phenolic compound content of 1.121%. Carrots, scientifically known as Daucus carota, present a valuable source of phenolic compounds, carotenoids, and other natural antioxidants. The utilization of leftover carrot peels to create readily consumable vegetable soup contributes to its potential as a nutraceutical source. This soup not only holds substantial dietary fibre content but also offers considerable nutritional value and potential nutraceutical benefits. The nutritional breakdown of carrots reveals Carbohydrates at 0.7 g per 100 g, Protein ranging from 9.70 g to 0.25 g per 100 g, Moisture content at 1152 g per 100 g, Polyphenol content ranging from 6.96 mg to 9.02 mg, Ash content ranging from 10.30 g to 0.25 g per 100 g, and Vitamin C at 0.1 mg per 100 g. (Chantaro *et al*., 2008) [7]. In the broader context, fruit and vegetable peels often face improper disposal, contributing to environmental degradation. Recognizing the rich nutraceutical content embedded in these discarded components underscores the importance of sustainable utilization.

Nutraceutical Potential of Various Vegetable Waste

Polysaccharides, proteins, fibres, flavourings, and phytochemicals are bioactive elements with high nutritional value that can be used to create nutraceuticals as well as ingredients for the creation of functional foods (Kumar, 2020) [22].

Niyi *et al*. have invented a creeping vine known as a cucumber (*Cucumis sativus*) that produces cylinder-shaped fruits, a member of the Cucurbitaceae family of gourds (Niyi *et al*., 2019) [31]. The nutraceutical potential of cucumber is carbohydrate-2.9 g, Protein-7.0 g/10 g, Fibre-23.0 g/100 mg, Iron- 7.39 g, Potassium 0.01 g, Calcium-2.62 g, Ash-23.0 g/100 g,7.85 g, Total phenolic compound-1.121%.

Chanthro *et al*. have invented Daucus carota, or carrots, which are a good source of phenolic compounds, carotenoids, and other natural antioxidants. The leftover carrot peels are utilized to make a ready-to-drink vegetable soup. contains significant levels of dietary fiber, nutritional value, and potential nutraceutical benefits (Chantaro *et al*., 2008) [7]. The nutraceutical attributes of carrots encompass a carbohydrate content of 0.7 g per 100 g, a protein range varying from 9.70 g to 0.25 g per 100 g, a moisture content of 1152 g per 100 g, polyphenol levels spanning from 6.96 mg to 9.02 mg, an ash content ranging between 10.30 g and 0.25 g per 100 g, and a vitamin C content of 0.1 mg per 100 g. Regrettably, the peels of fruits and vegetables are often carelessly discarded into the environment, leading to a concerning cycle of environmental degradation.

Lagenaria siceraria (Molina) Standl, a typical vegetable consumed in India, is an example of a waste material that can be reused by being transformed into various value-added uses, such as nutritious soup (Menpara *et al*., 2014) [28].

Table 1: Nutraceutical potential of various vegetable peel

S. R.	Author	Target	Targeted vegetable waste	Nutritional values
1	(Salari *et al*., 2019) [39], (Niyi *et al*.,2019) [31], (Zeyada, 2008) [49]	• Vegetable Peels Promising Resource for Livestock • Comparative Assessment of The Proximate, Mineral Composition, And Mineral Safety Index of Peel, Pulp, And Seeds of Cucumber (*Cucumis sativus*)	• Cucumber Peel	• Carbohydrate-2.9 g, • Protein-7.0 g/10 g • Fibre-23.0 g/100 mg • Iron- 7.39 g • Potassium-0.01 g • Calcium-2.62 g • Ash-23.0 g/100 g,7.85 g • Total phenolic compound-1.121%
2	(Hassan *et al*., 2008) [15], (Salari *et al*., 2019) [39]	• Vegetable Peels Promising Resource for Livestock • The Nutritive Value of Banana Peel (Musa Sapieutum L.)	• Green Banana Peel	• Carbohydrate- • Protein- 7 g/100 g • Fibre- 24.1 g/100 g • Vitamin A - • Ash- 8.8 g/100 g
3	(Hassan *et al*., 2008) [15], (Zeyada, 2008) [49]	• Vegetable Peels Promising Resource for Livestock • Utilization Of Some Vegetables and Fruits	• Potato Peel	• Carbohydrate-70 g/100 • Protein-, 13 g/100 g • Fibre-12.5 g/100 g

		Waste as Natural Antioxidants		• Fat-1.17 g/100 g • Vitamin A - • Ash-9 g/100 g • Phenolic content -86.3 mg GAE/100 g,0.039% • Flavonoid content-r 27.5 mg GAE/100 g dw • Moisture-5.66 g/100 g
4	(Stokstad, 2019) [46], (Amin *et al*., 2018) [4], (Šeregelj *et al*., 2021) [40]	• The Bioactive Potential of Fruit and Vegetable Waste • Peeling Affects the Nutritional Properties of Carrot Genotypes • Natural bioactive compounds in carrot waste for food applications and health benefits	• Carrot Peel	• Carbohydrate- 0.7 g/100 g • Protein-9.70- 0.25 g/100 g • Moisture content-1152 g/100 g • Polyphenol-6.96-9.02 mg • Ash-10.30 -0.25 g/100 g • Vitamin c- 0.1 mg/100 g
5	(Ranganathan *et al*., 2017) [37], (Swetha & Muthukumar, 2016) [47]	• Characterization Of Nutrients, Amino Acids, • Polyphenols And Antioxidant Activity of Ridge Gourd (*Luffa acutangula*) Peel	• Ridge Gourd Peel	• Moisture -12.40% • Carbohydrate-38.9% • Protein-14.26% • Ash-7.70% • Fibre-20.60% • Fat-6.10%
6	Prerna Gupta *et al*. (2019) [13] (P. Gupta *et al*., 2021) [14], (Jin & Jin, 2021) [17], (Sreenivas *et al*., 2014) [45]	• Pharmacological And Biomedical Application • Re-utilization of ash gourd (*Benincasa hispida*) peel waste for chromium (VI) biosorption: Equilibrium and column studies • Antimicrobial Activity of Zinc Oxide Nano/Microparticles and Their Combinations against Pathogenic Microorganisms for Biomedical Applications: From Physicochemical Characteristics to Pharmacological Aspects	• Ash Gourd Peel	• Moisture -3.70% • Protein- 3.6 ± 0.08 g • Fat-0.1 g • Carbohydrate-2.3 g • Iron-1.01 mg • Calcium-19 mg • Fibre-1.1 g
7	(Kujala *et al*., 2001) [21], (John *et al*., 2017) [18] ("Chemical Composition and Antioxidant Activities of Beetroot Peel.," 2020) [8]	• Chemical Composition and Antioxidant Activities of Beetroot Peel. • Betalains and Phenolics in Red Beetroot (Beta vulgaris) Peel Extracts: Extraction and Characterization • Antioxidant and Antibacterial Activities of Beta vulgaris L. Peel Extracts.	• Beetroot Peel	• Moisture content-30.88% • Ash content-10.58% • Protein content-4.10% • Carbohydrate content-44.17% • Fibre- 6.98% • Cu-0.21
8	(Batool *et al*., 2022) [6], (Mala & Kurian, 2016) [27], (Jun *et al*., 2006) [19]	• Nutritional Value, Phytochemical Potential, And Therapeutic Benefits of Pumpkin (*Cucurbita* Sp.) • Nutritional composition and antioxidant activity of pumpkin wastes • Characterization of the pectic polysaccharides from pumpkin peel	• Pumpkin Peel	• Carbohydrate -12.407 mg/g • Ash-7.317 mg/g • Fat- • Fibre-13.383 mg/g • Protein-14.670 mg/g • Ca-1.360 mg/g • Mg-3.353 mg/g • Iron-4.004 mg/g

The Cucurbitaceae family includes *Cucumis sativus* L. It is a vegetable crop that is indigenous to India but is grown commercially all over the world. Fresh, pickled, or cooked as a vegetable, it is frequently eaten raw in salads. Cucumber has a variety of medicinal uses, including as a skin refresher, emollient, itching reliever, antioxidant anti-wrinkle, antimicrobial, antidiabetic, treatment for ulcers and colitis, hypolipidemic, and wound healer, among others. Although cucumber peel and plant are typically regarded as waste, alkaloids, saponins, diterpenes, steroids, and flavonoids have been found through qualitative phytochemical analyses developed in cucumber peel extracts. The extracts also demonstrated modest antioxidant and antibacterial activities. Crude proteins (42%) and fats (42.5%) make up most of the seed's makeup; fiber and carbohydrates are scarce. The nutraceutical properties of cucumber carbohydrate-2.9 g, protein-7.0 g/10 g, fibre-23.0 g/100 mg, iron- 7.39 g, potassium-0.01 g, calcium-2.62 g, ash-23.0 g/100 g,7.85 g, total phenolic compound-1.121% (Espinosa-alonso & Valdez-morales, 2020) [9] (Guler *et al*., 2013) [12] (Wilhemina Kalt, 2005) [48] (Pangestuti & Arifin, 2018) [34] (Niyi *et al*., 2019) [31] According to the Food and Agriculture Organization, the potato (*Solanum tuberosum* L.), one of the most important crops in the world, produced 180 million tons worldwide annually in 2009. A promising source of dietary fiber was unveiled as potato peel. Since dietary fibers make up about 50% of potato peels (w/w).The nutraceutical properties of potato peel Carbohydrate-70 g/100, Protein-, 13 g/100 g, Fibre-12.5 g/100 g, Fat-1.17 g/100 g, Ash-9 g/100 g, Phenolic content -86.3 mg GAE/100 g,0.039%, Flavonoid content-r 27.5 mg GAE/100 g DW, Moisture-5.66 g/100 g (Al-Weshahy & Rao, 2012) [3] (Wilhemina Kalt, 2005) [48] (Sonia *et al*., 2016) [44] (Khan, 2016) [20].

The scientific name of the bottle gourd is *Lagenaria siceraria*, commonly known as Pani Lau. This versatile vegetable thrives across our nation and holds particular significance during the summer months due to its refreshing fruit, which offers notable health benefits. Its leaves are utilized in treating jaundice through a decoction combined with sugar, while the juice extracted from its warm stem is used to alleviate ear pain. Impressively, approximately 84% of the fruit is consumable as it continues to grow. In a comparative context, bottle gourds with their peel exhibit heightened levels of crude fiber, acid-detergent fiber, hemicelluloses, iron, phosphorus, and zinc in comparison to those without the peel. The leaves contain Cucurbitacin B and have shown antibiotic properties. Extracts derived from the plant have demonstrated antibiotic properties. In terms of nutritional content, the bottle gourd peel investigated in this study displayed a caloric content of 2278.1 kcal ME/kgDM, 7.0 g/100 g of crude protein, 23.0 g/100 g of crude fiber, 2.1 g/100 g of ether extracts, 58.3 g/100 g of nitrogen-free extracts, and 9.6 g/100 g of ash. Moreover, the nutritional breakdown showed DM at 12.0 g/100 g, CP at 2.0 g/100 g, CF at 1.0 g/100 g, EE at 6.0 g/100 g, and ash at 2.0 g/100 g. Interestingly the findings from this study diverge from prior research, suggesting that bottle gourds could offer an alternative feed option for livestock. (Hossan *et al*., 2015) [16] (Lutfullah *et al*., 2014) [26]

Solanum melongena, a member of the Solanaceae plant family, gives rise to a fruit of the same name, widely employed in culinary applications. This fruit is a part of the nightshade family, akin to the potato and tomato. Its domestication can be traced back to India. Notably, cows fed GM Brinjal exhibited a substantial increase in milk production, around 14.3%, reminiscent of a mild hormone treatment over a mere 42-day period. In the scope of the present investigation, brinjal peel exhibited nutritional content including a ME/kgDM of 2231.2, crude protein at 12.3 g/100 g, crude fiber at 26.8 g/100 g, ether extracts at 1.6 g/100 g, nitrogen-free extracts at 52.7 g/100 g, and ash at 6.6 g/100 g (Hossan *et al*., 2015) [16] (Shadrach *et al*., 2020) [41].

The plant's scientific designation is Musa sapientum, a member of the Musaceae family. This herbaceous plant, known for its rapid growth, boasts a stem that can reach heights of three to five meters, with virtually all its components being fit for consumption. As noted by Leslie (1976) [52], it currently thrives across tropical regions. Its cultivation primarily centers on its fruits, while fiber production serves as a secondary purpose. Notably, the peel of this plant has versatile applications, including its use in crafting banana charcoal, an innovative form of cooking fuel in Kampala. Kudan (1973) [50] attests to the peel's potential to create a liniment, which, when combined with other ingredients, offers relief from arthritis pain and discomfort. Intriguingly, peel waste contributes to 18-20% of the total waste produced by bananas. In terms of nutraceutical attributes, Musa showcases Protein content at 7 g/100 g, Fiber at 24.1 g/100 g, and Ash at 8.8 g/100 g. (Hossan *et al*., 2015) [16] ("Chemical Composition and Antioxidant Activities of Beetroot Peel.," 2020) [8]

Cucurbita moschata, commonly known as Mistikumra, stands as its colloquial title. The versatile fruits of this plant are consumable as vegetables. These mature squash gourds find utility not only as a table vegetable for baking into pies and making jams but also as a valuable component of livestock feed. The texture of the meat, characterized by its fine grains and mild flavor, renders it an excellent choice for baking purposes. Additionally, it holds nutritional value with its content of both vitamin C and A. The ongoing study's exploration of pumpkin peel revealed intriguing nutritional attributes. Specifically, the pumpkin peel displayed a caloric content of 2.754 kcal ME/kgDM, a crude protein content of 16.5 g/100 g, a crude fiber content of 14.8 g/100 g, ether extracts at 1.9 g/100 g, nitrogen-free extracts at 62.2 g/100 g, and ash at 4.6 g/100 g. Evidently, the pumpkin peel emerges as a nutritionally dense entity, suggesting its potential significance as livestock feed (Hossan *et al*., 2015) [16] (Zeyada, 2008) [49] (Singh & Kumar, 2022) [43] (Batool *et al*., 2022) [6].

Table 2: Nutraceutical potential of various vegetable seed

S. no	Author	Target	Targeted Vegetable Waste	Nutritional Values
1	(Hossan *et al*., 2015) [16], (Niyi *et al*., 2019) [31] (Zeyada, 2008) [49]	• Comparative Assessment of The Proximate, Mineral Composition, And Mineral Safety Index Of Peel, Pulp, And Seeds of Cucumber (*Cucumis sativus*) • Vegetable Peels Promising Resource for Livestock • Utilization of Some Vegetables and Fruits Waste As Natural	• Cucumber Seed	• Protein- 26.68 g • Fibre- 32.27 g • Fat- 14.14 g • Calcium- 3.024 g • Potassium- 541 ± 0.01 g • Total Flavonoid- 0.36% • Total Phenolic Content- 0.40%
2	(Hassan *et al*., 2008) [15], (Hossan *et al*., 2015) [16], (Amin *et al*., 2018) [4], (Pradhan *et al*., 2013) [35], (Abdel-Razek *et al*., 2021) [1]	• The Nutritional Value of Bottle Gourd • Vegetable Peels Promising Resource for Livestock • *In vitro* Antioxidant and Antibacterial Activities of Pumpkin, Quince, And Bottle Gourd Seed • Physical properties of bottle gourd seed • Efficacy of Bottle Gourd Seeds' Extracts in Chemical Hazard Reduction Secreted as Toxigenic Fungi Metabolites	• Bottle Gourd Seed • Bottle gourd Seed	• Carbohydrate- 9.92% • Moisture Content- 17.5% • Ash Content- 5.80% • Protein Content- 19.25% • Potassium Content-1.58 Mg/G • Calcium -0.36 Mg/G • Iron- 2.34 Mg /G • Moisture- 2.32% • Ash- 2.78% • Crude Protein- 38.8% • Crude Fibre- 4.013% • Carbohydrate- 12.08%
3	(P. Gupta *et al*., 2021) [14], (Lee *et al*., 2005) [24], (Pallavi *et al*.,	• Pharmacological And Biomedical Application	• Ash Gourd Seed	• Moisture content-4.9% • Protein- 4.89 ± 0.928%

	2018) [33],	• Anti-angiogenic effect of the seed extract of *Benincasa hispida* • Development of chocolates enriched with prebiotics from ash gourd seeds • Effect of fruit size on seed quality of ash gourd (*Benincasa hispida*).		• Crude fat- 11.63 ± 1.07% • Fibre- 2.41 ± 10.12% • Ash- 11.86 ± 0.57% • Carbohydrate-4 g
4	Arunima *et al* (2021) [51], Hassan *et al*. (2008) [15]	• Nutritional, Phytochemical, And anti-microbial Attributes of Seeds and Kernels of Different Pumpkin cultivars • Invitro Antioxidant and Antibacterial Activities of Pumpkin, Quince, And Bottle Gourd Seed	• Pumpkin Seed	• Moisture Content -6.56% • Ash content-5.4% • Carbohydrate content-17.45% • Fat-33.13% • Fibre-10.63% • Protein-34.5% • Mg-352.8 mg/g • Ca-11.7 mg/g • Na-6.52 mg/g • TFC-23.65 mg/g • TPC-35.6 mg/g

Niyi *et al*. (2008) [31] invented the cucumber seeds' protein concentrations ranged from 15.9 to 26.5 g/100 g, while their fat contents ranged from 0.13 to 1.44 g/100 g. Cucumber pulp and seed fiber content in the current study ranged from 3.00 to 8.86 g/100 g. The pulp had the highest level (8.86 g/100 g), and the seed had the lowest amount (3.00 g/100 g). Cucumber seeds had 33.7 to 52.7 g of carbohydrates per 100 g. The cucumber seed has an energy content that ranged from 1077 to 1296 kJ/kg. The energy level in seeds was the greatest ever observed (1296). Compared to the pulp and peel, the cucumber seed has the most iron (9.08 mg/100 g). Compared to the pulp and peel, the cucumber seed has the most iron (9.08 mg/100 g). For preventing anemia, iron is said to be a crucial component of the diets of expectant mothers, nursing mothers, and infants

According to (Hassan *et al*., 2008) [15] the crude protein content of pumpkin seeds was found to be 34.870.051%, the ash content of pumpkin seeds was found to be (3.4240.319%), the total carbohydrate represents NFE, and the fat content of quince seeds was calculated to be (22.6950.871%). The moisture content of pumpkin seeds was found to be 5.960.02% and was in the range. Quince seeds (2.813 0.018%) had the lowest NFE, and pumpkin seeds (32.556 0.347%) had the highest NFE (Amin *et al*., 2018; Arowora *et al*., 2017) [4] (Hassan *et al*., 2008) [15] examined the mineral, amino acid, and proximate compositions of bottle gourd seed (*Lagenaria siceraria*). The analysis's findings revealed that the whole seed has the highest content of moisture (17.5 0.21%) and ash (5.80 0.83%), while the dehulled had the highest amounts of crude protein (35.0 0.48%) and crude lipid (39.22 1.48%), and the seed coat has the highest amount of crude fiber (59.05 0.98%) (Hassan *et al*., 2008) [15].

Conclusion and future scope

It is clear from several studies of the wide diversity of bioactive chemicals found in food residues and the accessibility of extremely sensitive measuring methods that there is a significant opportunity to quantify metabolites in various food waste materials. A growing amount of food and agricultural waste is available due to the establishment of food processing industries and post-harvest losses of fruits and vegetables. If this waste is used as a source of bioactive compounds, it will improve farmers' financial standing and lessen the burden of waste management. Fruit and vegetable processing waste products including peels, seeds, and stones can be successfully employed as a source of phytochemicals and antioxidants. Because these are high-value goods and their recovery may be financially lucrative, there is growing interest in the novel features relating to the utilization of these wastes as by-products for further exploitation in the creation of food additives or supplements with high nutritional value. The by-products are a significant source of sugars, minerals, organic acids, dietary fiber, and phenolics, which have a variety of actions, including anti-tumor, antiviral, antibacterial, cardioprotective, and antimutagenic properties. In addition, a significant waste disposal issue arises in India due to the high percentage of industrial waste that is wasted. In addition, a significant waste disposal issue arises in India due to the high percentage of industrial waste that is wasted. The current review investigates the methods by which bioactive chemicals that can be employed as nutraceuticals and dietary supplements can be extracted using various technologies.

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