



Exploring the Potential and Prospects of Underutilized Vegetables- A Review

NIDHI KUKREJA and PARUL SHARMA*

Food Science and Nutrition, Banasthali Vidyapith, Rajasthan.

Abstract

Vegetables are wholesome and inseparable part of the human diet. They are the major providers of minerals, vitamins and trace elements which are essential for the normal sustenance of humans. There are some underutilized vegetables which are not included into the normal foods. These are either neglected or not popular as other conventional vegetables but have tremendous potential and can have much significance in human life. These are abundant sources of antioxidants and phytochemicals and can act as nutraceutical. Therefore, these could be included into the daily diet regime of individuals without any hesitation. In cases of issues related to nutrition like allergies, deficiencies, these should be taken into the utmost consideration. They also remove monotony from the regular or traditional fruits and vegetables. Hence, this present paper displays the significance and potentials of some underutilized vegetables and strategies that can be implied to utilise these and include them into our daily life.



Article History

Received: 30 April 2023

Accepted: 24 November 2023

Keywords

Conventional vegetables; Human diet; Potentia; Strategies; underutilized Vegetables.

Introduction


Vegetables being major origin of important nutrients with antioxidants are principle component of proportionate diet of humans and are chief operators in attaining national nutritional security by catering nutrients¹² There are various varieties of edible vegetables and fruits accessible that have the properties to fight against any disease and that are easily accessible, low at price but are undiscovered therefore, underutilized such as Spine gourd, Sword bean, Bitter cucumber, Wild cowpea, Water spinach and others. These species have potency to give elated levels of micronutrient like vitamins, minerals and various bioactive components.⁶⁴

Vegetables and Fruits have abundant crucial fibers, minerals, vitamins along with ailment controlling phytonutrients that humans requires to conserve optimal health. Certain veggies can be eaten fresh but many are cooked prior consumption. Basically, preparing vegetables in home are rooted towards flavour choices and satisfaction rather than holding onto the nutrient and health-promoting components.²⁴ Thus, vegetables that are neither grown for trade nor merchandised broadly are known as underutilized. Underutilized vegetables enclosed of good nutritional and medical potency with attribute of standing against unfavourable weather situations. Despites, these vegetables are

CONTACT Parul Sharma ✉ parulagmn@gmail.com 📍 Food Science and Nutrition, Banasthali Vidyapith, Rajasthan.



© 2023 The Author(s). Published by Enviro Research Publishers.

This is an  Open Access article licensed under a Creative Commons license: Attribution 4.0 International (CC-BY).

Doi: <https://dx.doi.org/10.12944/CARJ.11.3.02>

still unheeded because of shortness of awareness and absolute knowledge. Diverse names are used to elaborate range of underutilized crops. Some of the titles are underdeveloped, lost, abandoned, minor, underused, alternative, traditional, local, forgotten, niche, neglected, promising and Orphan.⁵² These vegetables have local or territorial significance and ideally used for its fruit, oil, fodder, fibre etc. but remains deficit in public acceptance with amplification. Underutilized vegetables have vital role in rural humans. They have capability to boost financial status by occupational possibilities and revenue generation and also by enhanced effectiveness and profitability gains of labour in agrarian and urbanised states. Usage of underutilized crops is the mean to lower the probability of over-dependency on small number of main vegetable crops. Alongside, they attribute to sustainable livelihood by domestic food security owing to additional edible vegetable crop choices.¹² Still, numerous vegetable crops conventionally eaten by localised people are considered underutilized.

The nutritional profile of these vegetables is high as compared to usually refined veggies which have medical potency.⁶⁷ A broad scope of crops flourishing around Himalayas and sub Himalayas areas in India connecting to species Brassicaceae, Cucurbitaceae, Solanaceae along with different varieties of roots, beans, spices, tubers with some leafy crops contributes to wide range of underutilized vegetables.⁴¹

Because of lack of sustainability of planting matter, deficit on awareness in nutritional and medicinal significance, lack of information on absolute practises for improvement of these crops, usage of these crop usages is pitiable.⁷³ Underutilized vegetables enhances hunger, directly leading in enhancing production of food in provocative conditions, through nutritional enrichment in diet consisting conventional crops, and giving poor people the buying capacity for food which is available.⁴⁰ These plants serve as indispensable constituent of human diet supplying body with minerals, vitamins and certain hormone precursors, in addition to protein and energy. According to FAO (Food and Agricultural Organisation) report, more than one billion people are using these plants as their diet.⁶³

Importance of Underutilized Vegetables

A broader usage of unattended and underused veggies, either with subsequent major staples or as single crops, would give various choices to make temporary and spatial diversity in the regular yielding, progressing to more sustainable catering of various nourished food crops. Many conventional or endemic vegetables are known for its high nourishment value analysed with other vegetables like cabbage, tomato.³¹ As the generator of important protein, micronutrients, vitamins and other phytochemicals, indigenous vegetables or undervalued crops consists of the potency in achieving nutritional security. Besides necessary vitamins, many of these vegetables indulged in backyard are to be generally nutritional proficiency.²³ Also, their commercialised, traditional and cultural valued, therapeutical veggies are advised crucial for organic farming as they lower the effect in manufacture apparatus of the environment. Much of these food crops are robust, altered to circumstantial peripheral soil with atmospheric phenomenon, matured in negotiable extraneous inputs.^{22,11} Underutilized vegetables comprise important natural assets in agricultural insufficient areas with addition in enhancing the benefits of many tribal people. Concentrating on undervalued vegetables is a competent manner in assisting different and nutritious diet with accomplishing micronutrient insufficiency.¹²

Characteristics of underutilized Vegetables

1. Vegetable crop should have any scientific evidence of intellectual nourishment.
2. They should be nurtured formerly or only grown and used in particular geographical areas.
3. Vegetable crops should have restricted or improper seed distribution route.
4. Vegetable crops are presently cultivated fewer as compared to other traditional crops.
5. Vegetable crops have attained fewer acknowledgements of customers, farmers, scientists and influential rule makers.⁷¹
6. Vegetable crops should have excellent nutritional profile with therapeutical/ medicinal properties along with multiple usages.²⁷

Table 1: Recommended dietary allowance (RDA) & Estimated Average Requirements (EAR) for Indian Males and Females (ICMR- NIN, 2020)

Nutrients(Minerals/ Trace Elements)	RDA (Males)	RDA (Females)
1. Calcium	1000 mg/day	1000 mg/day
2. Magnesium	440 mg/day	370 mg/day
3. Iron	19 mg/day	29 mg/day
4. Zinc	17 mg/day	13 mg/day
5. Iodine	150 µg/day	150 µg/day
6. Phosphorous	1000 mg/day	1000 mg/day
7. Sodium	2000 mg/day	2000 mg/day
8. Potassium	3500 mg/day	3500 mg/day
9. Copper	2 mg/day	2 mg/day
10. Manganese	4 mg/day	4 mg/day
11. Selenium	40 µg/day	40 µg/day
12. Chromium	50 µg/day	50 µg/day
Vitamins	RDA (Males)	RDA (Females)
13. Thiamine	1.8 mg/day	1.7 mg/day
14. Riboflavin	2.5 mg/day	2.4 mg/day
15. Niacin	18 mg/day	14 mg/day
16. Vitamin B6	2.4 mg/day	1.9 mg/day
17. Folate	300 µg/day	220 µg/day
18. Vitamin B12	2.2 µg/day	2.2 µg/day
19. Vitamin C	80 mg/day	65 mg/day
20. Vitamin A	1000 µg/day	840 µg/day
21. Vitamin D	600 IU	600 IU

Table 2: List of underutilized vegetables with their scientific names (Chacha et al., 2020; Kumar et al., 2018; Shukla et al., 2019; Jena et al., 2018)

Scientific Name	Local Name
1. Sunga	Bitter lettuce
2. Kikundembala	Wild cowpea
3. Mokiki	Bitter cucumber
4. Inyiri	Malabar spinach
5. Lasia Spinosa	Gantha
6. Ipomoea Aquatica	Water spinach
7. Momordica Dioca	Spine gourd
8. Oroxylum Indicum	Sonapatha
9. Homalomena Aromatic	Sugandhmantri
10. Canavalia Gladiata	Sword bean
11. Enhydra Fluctuans	Helencha
12. Solanum Torvum	Wild brinjal
13. Amaranthus spinosus L	Spiny Amaranthus
14. Amorphophallus Companulatus	Elephant foot yam
15. Ocimum Americanum	American Basil

Profile of Some underutilized Vegetable Crops⁹ Sunga (Bitter Lettuce)

Sunga crop is an undomesticated, blossom in white or yellow hues.⁴² *L. cornuta* is usually called as bitter lettuce which is wild vegetable that belongs to family group of Asteraceae/ Compositae.¹⁴ It is mainly found in Sudan, Zimbabwe, Kenya, Somalia, Ethiopia, Tanzania, Nigeria and Uganda.²⁹ This vegetable is rich in vitamins {especially Vit. A [β -Carotene](3.8 mg/100g), B1 (25.2 mg/100g), B2 (0.24 mg/100g), B3 (0.1 mg/100g), C (120.8 mg/100g)} and minerals {especially iron (6.04 mg/100g), zinc (6.05 mg/100g), magnesium (301.5 mg/100g) and calcium (60.2 mg/100g)}.⁹ It is utilised in treating sore throats, typhoid, malaria, measles, ear aches, diabetes, coughs, gonorrhoea, joint pains, chicken pox, nasal-pharyngeal infections, hernia, syphilis.^{46, 75, 45}

Kikundembala (Wild Cowpea)

Vigna is genus of essential legume group Phaseoleae.⁶⁶ Normally it is known as "wild cowpea". It's the inbred of Asia, Central America and Africa.³³ It pertains from group Fabaceae.⁵ This vegetable can be preserved for a year if all conditions are in favour. This crop is abundant in micronutrients such as zinc and iron.³⁵ This vegetable is enriched with vitamins {especially Vit. A [β -Carotene] (2.5 mg/100g), B1 (18.9 mg/100g), B2 (0.18 mg/100g), B3 (0.09 mg/100g), C (136.7 mg/100g)} and minerals {especially iron (4.2 mg/100g), zinc (4.28 mg/100g), magnesium (191.1 mg/100g) and calcium (85.2 mg/100g)}.⁹ It is helpful in curing ailments related to eyes, hernia, provides relief in menstrual pain.

Mokiki (Bitter Cucumber)

Commonly called as seed-bearing leafy crop, *M. foetida* is a delicate, wide and spoon-shaped leaf. *M. foetida* a medicative crop belonging to the family of Cucurbitaceae.⁴⁴ It is a monoecious, long mounting herbaceous plant. Generally called as bitter cucumber or bitter melon, vegetable of *Mormodica* genus, Cucurbitaceae family is distinguished by the sharp flavour due to the existence of phytochemicals cucurbitacins and alkaloids.⁴⁷ This vegetable is majorly grown in India, China, Bangladesh, Japan and Sri Lanka. It is helpful in treating diabetes, fever, small pox, blood pressure and malaria.³⁹ This vegetable is enriched with vitamins {especially Vit. A [β -Carotene] (5.5 mg/100g), B1 (58.3 mg/100g), B2 (0.76 mg/100g),

B3 (0.12 mg/100g), C (46.5 mg/100g)} and minerals {especially iron (21.05 mg/100g), zinc (21.1 mg/100g), magnesium (1151.9 mg/100g) and calcium (421.03 mg/100g)}.⁷

Inyiri (Malabar Spinach)

B. Alba a quick- spreading persisting creeping crop belongs to Basellaceae family.⁵⁸ It's generally called as Malabar spinach or vine spinach.^{60,53} It has tedious gluey flavour and no smell. This vegetable is of three kinds: *B. Alba* consists green stem with oval to nearly circular leaf, *B. rubra* consists red stems with green and oval to round leaf and third kind is the cross- breed of the other two kinds.⁶⁵ It contains ample vitamins like riboflavin, thiamine, niacin, ascorbic acid, vitamin A, K, E and B₉ and minerals such as zinc, iron, magnesium and calcium.⁶² This vegetable is enriched with vitamins {especially Vit. A [β -Carotene](6.6 mg/100g), B1 (182.9 mg/100g), B2 (0.54 mg/100g), B3 (0.4 mg/100g), C (198.08 mg/100g)} and minerals {especially iron (13.4 mg/100g), zinc (13 mg/100g), magnesium (524.5 mg/100g) and calcium (134.1 mg/100g)}.⁹ It also has phytochemicals like phenolic compounds and steroids. For medical grounds, leaf, roots, stems of this vegetable is boiled and acquired fluid is taken for curing anaemia, burns, scalds, constipation, dysentery,³⁶ headaches,²⁵ skin diseases, ulcers and haemorrhages.¹⁸

Lasia spinosa (Gantha)

Lasia spinosa is an enduring, blooming eternal crop belonging to family Araceae expanding 1 -2 metres in height with the help of elongated, climbing stem. Natively it is called as Gantha, kanta or Pachok Kwlwi in Tripura.¹³ Leaf and roots are used in ailing piles. This crop has vital pharmacological potential including anti-oxidant, anti-tumor, anti-diabetic, anti-bacterial, anti-hyperlipidemic, anti-helminthic with several other ailments inhibitory elements.²⁸ This vegetable is utilised in treatment of swellings, sprains, inflammation, scars and wounds in humans as well as cattle's (goats and cows).⁵⁶ Nutritional analysis of *Lasia spinosa* showed that Protein 17.6 kcal/100g, fats 1.16 kcal/100g, carbohydrate 35.7 kcal/100g and were present. Micronutrients like Zinc 7.44 ppm, Magnesium 6.22 ppm, Copper 0.31 ppm, Iron 17.06 ppm and Manganese 1.33 ppm were present.⁸

Ipomoea aquatica (Water Spinach)

Ipomoea aquatica is an amphibious, quick growing tropical crop grown as vegetable for its soft leaves and shoots. It belongs to Convolvulaceae family. The crop is called as river spinach, water spinach, water morning glory, water convolvulus. It's easily grown and available in hot and humid areas all over the world. It develops naturally into water and needs less attention. This crop is abundant in fibres, minerals, vitamins, carotene, proteins with flavonoids along with numerous health advantages.⁵⁴ This vegetable parts like leaves, stems are utilised in various forms such as juices, raw or cooked forms for curing cases of skin related disorders, snake bites and acts like medicine.⁵⁶ The leaves of *I. aquatica* contain the following: carbohydrate 4.3%, protein 3%, fat 0.4%, fiber 0.9%, mineral matter 2%, Vitamins nicotinic acid (0.6 mg/100g), riboflavin (120 mg/100g), C (137 mg/100g) and E (11 mg/100g).⁴³

Momordica Dioca (Spine Gourd)

Momordica dioca is called as spine gourd or kakrol belonging to Cucurbitaceae family. It is of high nutritional potential with medical and remunerative value. The unripe soft green fruits are eaten as a vegetable. Little flowers, leaves and seeds are also eaten. It is basically found in tropical areas of Asia, Africa and South America.⁷² This vegetable consists of various nutrients like vitamins, antioxidants, phytochemicals like alkaloids, carotenoids, steroids, triterpenoids, glycosides, saponins and polyphenols which comprises to the pharmacological properties.⁴⁷ This vegetable has properties like antibacterial, antiviral, antifungal, antimalarial, antiallergic, also it is utilised in curing diseases like cancer, piles, diabetes, asthma, neurodegenerative diseases, jaundice⁷ and urinary issues.⁴ The nutritional profile of the vegetable is: ash (14 g/100g), crude protein (52.06 g/100g), crude fiber (15.3 g/100g), crude fat (4 g/100g) and carbohydrate (14.5 g/100g). Levels of vitamins (g/100g [Dry Weight] DW) were A (2.5), B1 (1.8), B2 (3.5), B6 (4.3) and K (15). The values of minerals (mg/100g DW) were potassium (370), sodium (58), calcium (26000), zinc (8.5), Copper (1.7) and magnesium (14000).⁶¹

Oroxylum indicum (Sonapatha)

Oroxylum indicum is also called as Shyonaka or Sonapatha. It is vegetable species belonging to Bignoniaceae family. The height of this tree

can be upto 12 meters. It is basically grown in various parts of Sri Lanka, Malaysia, China, India, Thailand, Indonesia and Philippines.⁵⁵ In Tripura, fruits that are 1 to 3 foot in length, 2 to 4 inch wide are consumed as vegetable owing to the medical potency. In several families of India, seeds and bark of crop are used in treating respiratory problems, infections, pneumonia, fever.⁵¹ and vomiting, diarrhoea, dysentery.²⁶ It has various medicinal properties like antimicrobial, anticancer, anti-inflammatory, anti-ulcer, antibacterial, hepatoprotective and anti-dysenteric.³⁸ The nutritional profile of leaves of this vegetable is: copper (19.16 ppm), sodium (840.8 ppm), calcium (9311.7 ppm), manganese (26.26 ppm), iron (293.3 ppm), zinc (28 ppm).⁶⁸

Homalomena Aromatic (Sugandhmantri)

Homalomena aromatica Schott is natively known as Gandrwi that belongs to Araceae family. It's a fragrant rootstock perennial crop and found majorly in north-eastern areas and dispersed in Arunachal Pradesh, Assam, Tripura and Nagaland. This vegetable is heliophobic in nature alongside small, plumpy and strong stem, with standard length of 0.40- 0.80 m and heart-shaped dark green leaves with elongated petals. Its underground stem contains various medical factors like anti-inflammatory, antidepressant, sedative, pain relieving, antiseptic activities and ails pain in joints. It has crucial oils that are in huge demand in cosmetics and perfumery industries. Those medical and aromatic characteristics of the crop owe to the presence of particular antioxidants and phytochemicals.⁵⁹ The nutritional profile of leaves of this vegetable is: ash (24.9%), crude fat (1.14%), crude fiber (2.36%), protein (0.75%). Mineral estimation found: sodium (0.55 mg/g), potassium (3.16 mg/g), calcium (7.5 mg/g), copper (0.03 mg/g), zinc (0.77 mg/g), manganese (0.29 mg/g), iron (0.09 mg/g), magnesium (0.8 mg/g).⁶³

Canavalia Gladiata (Sword Bean)

Canavalia gladiata generally known as sword bean or Baikang is a crop species belonging to family of legumes Fabaceae. It is majorly found in parts of South Asia and Africa.³² The plant is strong, deep-rooted with continual mounting. The stems height can be 10 metres, distributing all-over ground or coinciding to nearby plant reinforcement. The seed has much lipid and protein, various minerals such as

Iron, Magnesium, Potassium, Sodium, Phosphorous and Calcium. It contains various ethno medical characteristics and urease, functional component of urea blood estimation.¹² The raw seeds of this vegetable contained considerable amount of protein (28.39%), lipid (7.84%), fiber (8.23%), ash (5.63%) and carbohydrates (49.91%).⁷⁴

Enhydra Fluctuans (Helencha)

Enhydra fluctuans is sticky plant, natively called as Alencha, belonging to Asteraceae family with excellent therapeutical potency. This is a comestible amphibious vegetable with irregular leaf. The leaf and stems are consumed as vegetable. The crop has nutritional value including cholesterol, saponins, glucoside and β -carotene. Leaf of this crop has little bitter and is helpful in ailing bronchitis, inflammation, laxative, nervous infections, skin diseases and small pox.³ Alongside, it supports Antidiarrheal, Antioxidant, CNS Depressant, Hepatoprotective, Pain relieving activity. It is helpful in treating chicken pox, rabies and dermatitis.⁵⁶ The protein content in this vegetable was 25.9 g/100gm, crude fiber was 24 g/100gm.²⁰

Solanum Torvum (Wild brinjal)

Solanum torvum is a hairy, straight and spiny perpetual crop. It is locally called as Khamka Shikam. It belongs to family Solanaceae.⁵⁶ This vegetable has generally 2 or 3 m height but might extend to 5 m. The crop has diuretic and sedative properties and leaf are consumed as sweeteners. Its fruit puree or decoction is helpful in ailing cough, chicken pox, spleen and liver elongation and heals poulticing cracks in foot.¹³ This vegetable is known abundant in calcium, iron, copper, zinc and Manganese. Because of excellent source of iron its fruit contains hematinic characteristics. The nutritional profile determined iron (76.8 mg/kg), manganese (19.4 mg/kg), calcium (221.5 mg/kg), copper (2.6 mg/kg) and zinc (21.46 mg/kg). Vitamins A and C contents were found to be 0.078 mg/100g and 2.6 mg/100g respectively.¹

Amaranthus Spinosus L. (Spiny Amaranthus)

Amaranthus spinosus, generally called as prickly amaranth, spiny amaranth, thorny amaranth or spiny pigweed is leafy crop belonging to family of Amaranthaceae. This vegetable is tiny, distinguished by existing spines in stems of the plant. Leaf of

the vegetable are exceptional source of protein. Commonly, roots and leaf have antileprotic, laxative, anti-diabetic, diuretic, anti-venom, anti-gonorrhoeal, antipyretic characteristics, acts as a medicine in easing eupneic in non-chronic bronchitis.² It also constitutes immunomodulatory activity, anti-inflammatory, anthelmintic properties and anti-androgenic activity. Its roots are utilised in curing blood dysentery.⁵⁶ It is also utilised in treatment of headaches, night blindness, diabetes, hypertension, anaemia.¹⁹ The nutritional profile of the vegetable is as follows: proteins- 9 gm and carbs 21.29 gm. Amaranthus leaves contribute 2% to 3% of the daily value of phosphorus and zinc, and from 1 to 4 % of iron per serving.¹⁶

Amorphophallus companulatus (Elephant foot yam)

Amorphophallus companulatus is a tropical tuber belonging to Araceae family. It is herbaceous, recurrent crop found plenty in Tripura plantations. It is locally known as Maan – gachh. The underground stems for storage or corms are dehydrated, bitter and strong, enhances flavour and appetite, used in pervert situations haemorrhoid, piles, inflammation, asthma, elephantiasis, haemorrhage, fatigue, abdominal pain, splenopathy, dysentery, amenorrhoea, anaemia, seminal weakness.⁵⁷ Along this, corms had antifungal, cytotoxic and antibacterial characteristics owing to existence of diterpenoid. The paste of this vegetable roots is utilised in curing skin ailments.⁵⁶ The nutritional profile of the vegetable is as follows: phosphorous (4.53 μ g/gm), potassium (38.1 μ g/gm), zinc (23.1 μ g/gm), iron (340.2 μ g/gm), magnesium (119.2 μ g/gm) and copper (32.6 μ g/gm).⁶⁹

Ocimum Americanum L. (American Basil)

Ocimum americanum, called American basil is a yearly crop containing with lavender or white blossoms pertaining from family of Lamiaceae. This crop is straight, vigorous generally 20 – 30 cm in height. The immature leaves with soft shoots are largely consumed as condiment by indigenous group of people in Tripura. It has different heavy smell with many medical properties. The crucial oil obtained from leaf contains anti-inflammatory property.⁷⁶ It is helpful in the treatment of ailments like malaria, cough, constipation and depression.³⁷ The nutritional profile of this vegetable is as follows.

Ascorbic acid (42.8 mg/100gm), B1 (69.5 mg/100 gm), β -carotene (65.5mg/100gm), Lycopene (0.3 mg/100gm), Tocopherol (0.56 mg/100gm).³⁰

Potential Roles and Scope of underutilized Vegetables

Many plant crops are utilised in different ways for various purposes such as medicinal and industrial. Today, majorly crops like wheat, rice, maize, potatoes are harvested to satisfy the 60% energy demands of humans.¹⁵ Although underutilized crops are excellent source of various nutrients and health-elevating components, also prevents from malnutrition and various chronic illnesses. Therefore, upgrading food chains including these crops into the diet regime can become helpful in improving overall health and nutrition.⁶

Properties of underutilized Vegetables

Medicinal Properties

Various underutilized crops have therapeutic characteristics which includes Antipyretic, Hypoglycaemic, Analgesic, Cordiostimulant, Hypotensive, Anti- androgenic, CNS depressant, Hypolipidaemic,⁵⁰ anti-inflammatory, anticancerous, anti-microbial, hepatoprotective.¹⁰

Nutritional Properties

Underutilized crops comprise of tremendous potential in assisting the budget in crop yielding as they compatible in extreme environmental surroundings. These usually have average calorie count, besides abundant in various other essential nutrients like phyto-chemicals, minerals and vitamins.⁵⁰

Biochemical Properties

The underutilized vegetables are abundant source of vitamin C, minerals etc. These crops are helpful in obviating deficiency of many ailments specially in developing nations. Enhanced usage of these crops would lead to more production and also accomplishing micro and macro nutrients deficiencies.²¹

Pharmacological And Immunological Properties:

these underutilized crops have potential and acts as a medicines /drugs /tonics that may be essential in healthcare and pharmaceutical industries.⁴⁹ Many local and tribal groups use these crops as the

eternal part of their conventional medical system as they are utilised in treating non-communicable diseases and enhances immunity power. Presence of dietary fibers like cellulose, hemi- cellulose, pectin, lignin, β - glucans, fructans with some organic acids like tartaric, citric, iso- citric, lactic, malic, oxalic and acetic and omega-3 fatty acids are essential components that contribute in treatment of various ailments, enhances growth and development and improve immunity. These crops are essential in owning pharmacological properties.⁷⁰

Major Issues and Concerns Related to underutilized Vegetables¹⁷

1. These might have special characteristics which are not usual as compared to other crops.
2. These may not be broadly administered or may be localised into a particular region.
3. These might not be grown onto huge scale on comparison with other common crops.
4. These attain very less focus and attention from farmers, researchers and other liable persons.
5. These might have abundant therapeutic, nutritional and medicinal properties.
6. These must aggravate production with diversification in agriculture.

Limitations of underutilized Vegetables¹⁷

1. Lack in information and knowledge about yielding, consuming, utilising these crops makes it more neglected and infamous.
2. Deficit awareness related to the benefits and scope in trade.
3. No advancement in raw materials and other material quality with no technological advancement in breeding and biotechnology.
4. Less interest and focus on underutilized crops by cultivators, researchers, scientists and extension people.
5. Few amenities such as market chains, infrastructure for underutilized crops leads to loss in trade, transports.
6. Appropriate policies with regulations related to investment, marketability and credibility.
7. Few technological resources managing various underutilized vegetables make it more conditional.

Schemes for Promoting Underexploited Vegetables:^{73, 12}

1. Concentration on localised practices with native awareness.
2. Supporting stakeholder society collabs and establishing state, territorial and foreign alliances.
3. Development reporting should be connected and widespread.
4. Estimating and enhancing the needs by trade-based approaches.
5. Enabling and amending the ability of agrarian wretched to manage with governmental and non- governmental authorities.
6. Interdisciplinary ways of practising.

Conclusion

Underutilized vegetables enclosed of abundant nutrients with medical potency besides the quality to remain in unfavourable weather. Yet, these crops are still undervalued owing to deficient in absolute knowledge regarding their potential, lack of sowing apparatus, low enlightenment on accommodation into manufacturing systems. These vegetables yield would fulfil the demands and shortage of availability and nutritional problems. It would lead to more generation and employment that would ultimately

support the national economy. In cases of nutritional deficiencies and allergies these can be employed and included into the diet which would contribute as a variety into the diet and would promote a healthy and active lifestyle. Thus, it's very important to hold up schemes on genetic resources investigation, supervision, usage and development in underutilized crops to ensure nutritional and food security in the near future.

Acknowledgement

All the authors contributed to this study. Nidhi Kukreja had the major contribution in preparing and drafting the manuscript. Along with the guidance and supervision of the whole research, Dr. Parul Sharma furnished with corrections, comments and revising the manuscript. The authors read and approved the final draft of the manuscript.

Funding

The author(s) received no financial support for the research, authorship, and/or publication of this article.

Conflict of Interest

The authors declare that they have no competing interests.

References

1. Akoto O., Borquaye L. S., Howard A. S. and Konwuruk N. Nutritional and Mineral Composition of the Fruits of *Solanum torvum* from Ghana, *Int. J. Chem. Biomol Sci.* 2015. 1(5), 222-226.
2. Alegbejo J. O. Nutritional Value and Utilization of *Amaranthus* (*Amaranthus* spp.) – A review, *Bayero J. Pure App. Sci.* 2013. 6, 136 – 143.
3. Ali M. R., Billah M. M., Hassan M. M., Dewan S. M. R. and Al- Emran M. 2013. *Enhydra fluctuans* Lour: A Review, *Research J. of Phar Tech.* 6(6), 927-929.
4. Amjad M. S., Qaeem M. F., Ahmad I., Khan S. U., Chaudhari S. K., Malik N. Z., Shaheen H., Khan A. M. Descriptive study of plant resources in the context of the ethnomedicinal relevance of indigenous flora: A case study from Toli Peer National Park, Azad Jammu and Kashmir, Pakistan. *PLOS ONE.* 2017.12(2): e0171896. Doi: 10.1371/journal.
5. B. E. van Wyk. The potential of South African plants in the development of new food and beverage products. *S. Afr. J. Bot.* 2011. 77, 857–868.
6. Baldermann S., Blagojević L., Frede K., Klopsch R., Neugart S., Neumann A., Ngwene B., Norkoweit J., Schröter D., Schröter A., Schweigert F. J., Wiesner M. and Schreiner M. 2016. Are Neglected Plants the Food for the Future? Thematic, Strategic Papers and Country Status Reports. 1-19. In Tyagi R. K, Pandey A., Agrawal A., Varaprasad K. S, Paroda R. S., Khetarpal R. K. (2018) Regional Expert Consultation on Underutilized Crops for Food and Nutritional Security in Asia and the Pacific – Thematic, Strategic Papers and Country Status Reports.

- Asia-Pacific Association for Agricultural Research Institutions (APAARI), Bangkok, Thailand, November 13-15, 2017, 349 pgs.
7. Bharathi L. K., Singh H. S., Shivashankar S., and Ganeshamurthy A. N. Characterization of a fertile backcross progeny derived from inter-specific hybrid of *Momordica dioica* and *M. subangulata* subsp. *renigera* and its implications on improvement of dioecious *Momordica* spp. *Sci. Hortic.* 2014. 172: 143–148.
 8. Brahma J., Chakravarty S. and Rethy P. Qualitative Estimation of the Presence of Bioactive and Nutritional Compound in *Lasia Spinosa*: An Important Vegetable Plant used by the Bodos of Kokrajhar District. *Int.J. ChemTech Res.* 2014, 6(2) pp. 1405-1412.
 9. Chacha J. S. and Laswai H. S. Traditional Practices and Consumer Habits regarding Consumption of underutilized Vegetables in Kilimanjaro and Morogoro Regions, Tanzania. *Int. J. Food Sci.* 2020. Vol 2020, 10 pages.
 10. Das R., Paul T. and Chowdhury R. Underutilize Vegetables and its Medicinal Property in Indian Contest: A review". *Act. Sci. Nutr. Health.* 2019. 3(8): 76-80.
 11. De la Peña R. C., Ebert A. W., Gniffke P., Hanson P. and Symonds R. C. 2011. Genetic Adjustment to Changing Climates: Vegetables. In *Crop Adaptation to Climate Change*, 1st ed.; Yadav S. S., Redden R. J., Hatfield J. L., Lotze- Campen H., Hall A. E., Eds.; John Wiley & Sons, Ltd.: Chichester, UK. pp. 396–410.
 12. Debbarma S., Jamatia J. and Singh T. C. Underutilized Vegetables, Importance and Its Utilization by the Tribal Community of Tripura, North-East India. *Indian J. Pure Appl. Biosci.* 2020. 8(2), 471-483.
 13. Dey P., Bardalai D., Kumar N. R., Subramani C., Mukherjee M. and Bhakta T. Ethnomedicinal Knowledge about Various Medicinal Plants Used by the Tribes of Tripura. *RJPP.* 2012. 4(6): 297-302.
 14. Faith A. and Matheka J. M. Micropropagation of *Launaea cornuta* - an important indigenous vegetable and medicinal plant. *Afr. J. Biotechnol.* 2016. 15(32): 1726–1730.
 15. FAO. 2010. The Second Report on the State of the World's Plant Genetic Resources for Food and Agriculture. Food and Agriculture Organization of the United Nations, Rome, Italy.
 16. Ganjare A. and Raut N. Nutritional and medicinal potential of *Amaranthus spinosus*. *Journal of Pharmacognosy and Phytochemistry.* 2019; 8(3): 3149-3156.
 17. Gugal A. and Kotiyal A. A review on current status and challenges in cultivation of underutilized fruits crops of India. *Pharma innov.* 2022. 11(5): 2255- 2259.
 18. Haneefa M. K. P., Mohanta P. G. and Nayar C. Formulation and evaluation of herbal gel of *Basella Alba* for wound healing activity. *J. Pharm. Sci. Research.* 2012. 4(1): 1642 – 1648.
 19. Herforth A. 2010. Promotion of traditional African vegetables in Kenya and Tanzania: a case study of an intervention representing emerging imperatives in global nutrition. Dissertation: Cornell University Library.
 20. Hossain M.E., Sarma S. M., Sikder H. and Kabir M. H. Nutritive value of *Helincha (Enhydra Fluctuans)*. *Online J. Anim. Feed Res.*, 2016. 6(1): 20-23.
 21. Hossain M. M., Rahim M. A. and Haque M. R. Biochemical properties of some important underutilized minor fruits. *J. Agric. Res.* 2021. Vol.5.
 22. Hughes J.d'A. and Ebert A. W. 2013. Research and Development of Underutilized Plant Species: The Role of Vegetables in Assuring Food and Nutritional Security. In *Proceedings of the 2nd International Symposium on Underutilized Plant Species: Crops for the Future—Beyond Food Security*; Massawe, F., Mayes, S., Alderson, P., Eds.; International Society for Horticultural Sciences (ISHS): Korbeek-Lo, Belgium. 2, 79–91.
 23. Hughes J.d'A. and Keatinge J. D. H. 2013. The Nourished Millennium: How Vegetables Put Global Goals for Healthy, Balanced Diets within Reach. In *High Value Vegetables in Southeast Asia: Production, Supply and Demand*; Proceedings of the SEAVEG 2012 Regional Symposium; Holmer R., Linwattana G., Nath P., Keatinge J. D. H., Eds.; AVRDC - The World Vegetable Center: Tainan, Taiwan. 11–26.

24. Igwemmar N. C., Kolawole S. A. and Imran I. A. Effect of heating on vitamin C content of some selected vegetables. *IJSTR*. 2013. 2(11); 209- 212.
25. Jadhav V. D., Mahadkar S. D. and Valvi S. R. Documentation and ethnobotanical survey of wild edible plants from Kolhapur district. *Recent Res. Sci. Technol*. 2011. 3(12): 58 – 63.
26. Jagetia G. C. A Review on the Medicinal and Pharmacological Properties of Traditional Ethnomedicinal Plant Sonapatha, *Oroxylum indicum*. *Sinusitis*. 2021. 5, 71–89. <https://doi.org/10.3390/sinusitis5010009>
27. Jena A. K., Deuri R., Sharma P. and Singh S. P. Underutilized vegetable crops and their importance. *RJPP*. 2018. 7(5): 402-407.
28. Kankanamge U. and Amarathunga D. Phytochemical and Ethno Pharmacological Properties of *Lasia spinosa* (Kohila): A Review. *WJPR*. 2017. 6, 1-9.
29. Karau M. G., Njagi M. N. G., Machocho K. A., Wangai L. N. and Kamau N. P. Efficacy and safety assessment of *Launaea cornuta* extracts in the management of diabetes mellitus. *Am. J. M. Sc*. 2014. 4(1): 1 – 7.
30. Karau G. M., Njagi E. N. M., Machocho K. A., Wangai L. N. and Nthinga M. J. Chemical Composition and in vitro Antioxidant Activities of *Ocimum americanum*. *Advances in Analytical Chemistry*. 2015, 5(2): 42-49. DOI: 10.5923/j.aac.20150502.03
31. Keatinge J. D. H., Yang R. Y., Hughes J.d'A., Easdown W. J. and Holmer R. The importance of vegetables in ensuring both food and nutritional security in attainment of the Millennium Development Goals. *Food Science*. 2011. 3, 491–501.
32. Kim S., Kang J. H. and Song K. B. Development of a Sword Bean (*Canavalia gladiata*) Starch Film Containing Goji Berry Extract. *Food Bioproc. Tech*. 2020. 13: 911–921.
33. Kumar P. G. M. and Shiddamallayya N. Documentation of wild plant tubers as food resources in Hassan District, Karnataka. *Int. j. appl. biol*. 2014. 5(2): 90–95.
34. Kumar R., Rajasree V., Sagar L., Tripura U., Karthick K., Karthick R. and Prasath G. Underutilized vegetables as rich source of medicinal value: A boon for the pharmaceutical industries and farmer income. *Int. J. Chem. Stud*. 2018. 6(4): 3320-3323.
35. Kumar S. and Kumar A. Study of some wild tubers /rhizomes as potential micronutrient supplements to the vegetarian diets of indigenous population of Jharkhand. *IJPS*. 2016. 5(1): 33–35.
36. Kumar S., Prasad A. K., Iyer S. V. and Vaidya S. K. Systematic pharmacognostical, phytochemical and pharmacological review on an ethno medicinal plant, *Basella Alba L*. *JPP*. 2013. 5(4): 53 – 58.
37. Kumari R., Anil Kumar A. and Kumar B. Quantitative Analysis of Ethnobotanical data in Chatra district, Jharkhand. *IOSR. J. Biotechnol. Biochem*. 2020. 6(5): 01-18.
38. Lalrinzuali K., Vabeiryureilai M. and Jagetia G. C. 2016. Investigation of the Anti-Inflammatory and Analgesic Activities of Ethanol Extract of Stem Bark of *Sonapatha Oroxylum indicum* In Vivo. *Int J Inflamm*. Article ID 8247014. Doi: 10.1155/2016/8247014.
39. Madalaa E. N., Piater L., Duberya I. and Steenkampa P. Distribution patterns of flavonoids from three *Momordica* species by ultra-high performance liquid chromatography quadrupole time of flight mass spectrometry: a metabolomics profiling approach. *Rev. Bras. Farmacogn*. 2016. 26(4):507–513.
40. Mayes S., Massawe F. J., Alderson P. G., Roberts J. A., S. N. Azam J. A. -Ali and Hermann M. The potential for underutilized crops to improve security of food production. *JXB*. 2012. 63(3):075–1079.
41. Mishra T. S., Singh H. M. and Mishra N. K. Scope of underutilized vegetables in North East region. *Rashtriya Krishi*. 2019. 14(2; December): 61-65.
42. Misonge J. O., Kinyanjui J. G., Kingori W. M. and Mwalukumbi J. M. Phytochemical screening and cytotoxicity evaluation of *Launea Cornuta* H. (*Asteraceae*) using brine shrimp merit. *Res. J. Med. Sci*. 2015. 3(4):116–120.
43. Mital M. N. and Desai T. R. Phytochemical and pharmacological profile of *ipomoea aquatica*. *Indian J. of Med Sci*. 2013. Vol. 67, No. 3 and 4. 49-60. DOI: 10.4103/0019-5359.121115.
44. Molehin O. R. and Adefegha S. A. Comparative study of the aqueous and ethanolic extract of

- Momordica foetida on the phenolic content and antioxidant properties. *IFRJ*. 2014. 21(1):401–405.
45. Muriira K., Eliud N. M. N., Alex K. M., Laura N. W. and Peter N. K. Efficacy and Safety Assessment of *Launaea cornuta* extracts in the management of diabetes mellitus. *AJMS*. 2014. 4(1): 1 – 7.
 46. Musila M. F., Dossaji S. F., Nguta J. M., Lukhoba C. W and Munyao J. M. In vivo antimalarial activity, toxicity and phytochemical screening of selected antimalarial plants. *J. Ethnopharmacol.* 2013. 146(2): 557 – 561.
 47. Nagarani G., Abirami A. and Siddhuraju P. Food prospects and nutraceutical attributes of *Momordica* species: A potential tropical bioresources—A review. *Food Sci. Hum. Wellness*. 2014. 3(3-4): 117–126.
 48. NIN. Revised Short Summary Report-2023. ICMR- NIN Expert Group on Nutrient Requirement for Indians, Recommended Dietary Allowances (RDA) Estimated Average Requirements (EAR)-2020.
 49. Omotayo A. O. and Aremu A. O. Underutilized African indigenous fruit trees and food–nutrition security: Opportunities, challenges, and prospects. *Food Energy Secur.* 2020. 9(3): 1-16.
 50. Pandey A. K., Dubey R. K., Singh V. and Vida E. Addressing the problem of micronutrient malnutrition in Neh region – underutilized vegetables as a source of food. *Int. J. Food Nutr. Sci.* 2014. 3(3): 77- 83.
 51. Panghal M., Arya V., Yadav S., Kumar S. and Yadav J. P. Indigenous knowledge of medicinal plants used by Saperas community of Khetawas, Jhajjar district, Haryana. *J. Ethnobiology and Ethnomed.* 2010. 6, 4-11.
 52. Peduruhewa P.S., Jayathunge K. G. L. R., and Liyanage R., “Potential of Underutilized Wild Edible Plants as the Food for the Future – A Review.” *J Food Secur*, 9(4) 2021: 136-147. Doi: 10.12691/jfs-9-4-1.
 53. Prajapati K. P., Singh B. S. and Jaiswal S. Overview on anti-ulcer activity of *Basella Alba*: a therapeutic herb. *IAAST*. 2014. 5:49–61.
 54. Prasad K. N., Shivamurthy G. R. and Aradhya S. M. *Ipomoea aquatica*, An Underutilized Green Leafy Vegetable: A Review. *Int. Botany*. 2008. 4(2), 123-129.
 55. Raghu A. V., George S., Renju Krishna V. and Sindhu K. K. Bioactive properties of phenolics present in *Oroxylum indicum*—a review. *J. pharmacogn. phytochem.* 2013. 2(3) 23–27.
 56. Rahmatullah M., Mollik M. A. H., Rashid M. H., Tanzin R., Ghosh K. C., Rahman H., Alam J., Faruque M. O., Hasan M. M., Jahan R. and Khatun A. A Comparative Analysis of Medicinal Plants Used by Folk Medicinal Healers in Villages Adjoining the Ghaghot, Bangali and Padma Rivers of Bangladesh. *AEJSA*. 2010. 4(1): 70-85.
 57. Ramalingam R., Hima B. K., Bindu M. B., Ravinder N. A. and Banji D. Phytochemical and anthelmintic evaluation of corm of *Amorphophallus campanulatus*. *Int. J. Pharma and bio sci.* 2010. 4, 1-9.
 58. Rathee S., Ahuja D., Rathee P., Thanki M. and Rathee D. Cytotoxic and antibacterial activity of *Basella Alba* whole plant: a relatively unexplored plant. *Pharmacology*, 2010. 3, 651–658.
 59. Roy S. J., Baruah P. S., Lahkar L., Gurung L., Saikia D. and Tanti B. Phytochemical analysis and antioxidant activities of *Homalomena aromatica* Schott. *J. Pharmacogn. Phytochem.* 2018. 8, 1379-1385.
 60. Roy S. K., Gangopadhyay G. and Mukherjee K. K. Is stem twining form of *Basella Alba* L. a naturally occurring variant? *Curr. Sci.* 2010. 98, 1370–1375.
 61. Salvi J. and Katewa S. S. Nutritional Composition of *Momordica dioica* fruits: As a wild vegetable. *J. Food Pharm. Sci.* 2015. 3(2):18-22.
 62. Sase S., Limaye R. P., Soni N. and Gaikwad S. To study the action of *Basella Alba* ethanolic extract on calcium oxalate *in vitro*. *International J- AIM*. 2013. 3(5): 1343 – 1346.
 63. Seal T. Nutritional evaluation of some wild edible plants of Meghalaya State in India and their ethnobotanical importance. *J. Chem. Pharm. Res.* 2015. 7(3):2296-2301.
 64. Shukla S. and Jain S. Underutilized Fruits: Lost Nutritional Treasure. *Think India Journal*. 2019. 22(30 Special Issue): 1417- 1431.
 65. Singh M., Kumari R. and Kotecha M. *Basella rubra* Linn: a review. *Int J Res Ayurveda Pharm.* 2016. 5(1): 206–223.

66. Sprent J., David I., W. Odee and Dakora D. F. African legumes: a vital but under-utilized resource. *JXB*. 2010. 61(5): 1257–1265.
67. Srinivasa V, Devaraju and Angadi A. 2018. Survey on underexploited vegetables and their medicinal importance in Chikamagalur district, Karnataka, India. In National conference on "Conservation, Cultivation and Utilization of medicinal and Aromatic plants" (College of Horticulture, Mudigere Karnataka, 2018). *Journal of Pharmacognosy and Phytochemistry*; SP3: 440-44.
68. Srinivas K. S. and Saraf A. A. Profile of Elemental Composition of *Oroxylum indicum* L. (Vent.) Collected from Different Geographical Regions of India. *PHCOG J*. 2011. 3(24):50-54. DOI: 10.5530/pj.2011.24.10.
69. Srivastava S., Verma D., Srivastava A., Tiwari S. S. and Dixit B. Phytochemical and Nutritional Evaluation of *Amorphophallus campanulatus* (Roxb.) Blume Corm. *J Nutr Food Sci*. 2014. 4(3): 1. doi: 10.4172/2155-9600.1000274
70. Srivastava R., Srivastava V. and Singh A. Multipurpose Benefits of an Underexplored Species Purslane (*Portulaca oleracea* L.): A Critical Review. *Environmental Management*, 2021. 1-12.
71. Thakur M. Underutilized food crops: Treasure for future *India. J. Food Sci*. 2014. 5(2), 174-183.
72. Thiruvengadam M., Rekha K., and Chung I.-M. Induction of hairy roots by *Agrobacterium rhizogenes*-mediated transformation of spine gourd (*Momordica dioica* Roxb. ex. wild) for the assessment of phenolic compounds and biological activities. *Sci. Hortic*. 2016. 198, 132–141.
73. Tripathy B., Sahu P., Rout S. and Pradhan K. 2020. Underutilized vegetables: crops for future. International Web Conference on "Biodiversity in Vegetable Crops for Healthier Life and Livelihood" 27-28 August, 2020, Bihar Agricultural University, Sabour, Bhagalpur.
74. Vadivel V., Doss A. and Pugalenth M. Evaluation of nutritional value and protein quality of raw and differentially processed sword beans [*Canavalia gladiata* (Jacq.)DC] seeds. *AJFAND*. 2010. 10:7. 28650 -2865.
75. Wambugu S. N., Mathiu P. M., Gakuya D. W., Tanui T. I., Kabanias J. D. and Kiama S. G. Medicinal plants used in the management of chronic joint pains in Machakos and Makueni Counties, Kenya. *J. Ethnopharmacol*. 2011. 137(2): 945 – 955.
76. Yamada A. N., Grespan R., Yamada A. T., Silva E. L., Silva, Filho S. E., Damião M. J., de Oliveira Dalalio M. M., Bersani-Amado, C.A. and Cuman R. K. Anti-inflammatory Activity of *Ocimum americanum* L. Essential Oil in Experimental Model of zymosan induced arthritis. *Am J. Chin Med*. 2013. 41(3), 913-926.