



## Potential of onion (*Allium cepa*) as traditional therapeutic and functional food: An update

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### ABSTRACT

The efforts to comprehend the ideal healthy state have invariably intrigued the minds of people which led to evolution of several treating and healing systems being established across the globe. Several folk and traditional medicines evolved among various cultures and communities that were generally disseminated verbally for example use of onion (*Allium cepa* L.) bulbs. Since antiquity, this bulbous crop is being used as a traditional nutraceutical and medicinal plant, that's why, this is known as protective food. Onion is one of the most common vegetables utilized for culinary purpose in every kitchen. It is used to cure cold, flu, indigestion, pain relief, as an antidiabetics, anti-asthmatic, antioxidant and anti-inflammatory. The ancient literature displayed the onion as an utmost important part of human diet due to its multidimensional uses for thousands of years. However, the masses are not aware about its importance as a traditional remedy. Now, the utmost focus has been directed towards the evaluation of the medicinal values of this interesting and fascinating vegetable crop. It can also be recommended that utilization of plant-based nutraceuticals is better than devouring synthetic drugs against known and specific diseases. Furthermore, various vegetables and fruits are being used as a part of many recommended dietetic plans to prevent and lessen the common metabolic and lifestyle related diseases. The 21<sup>st</sup> century is going to work on the principle of "Food as Medicine" and onion will surely play a bigger role in it. This thoroughly collected information about onion as traditional medicine is the first of its kind in disseminating information about the much consumed and less researched vegetable crop of India.

**Keywords:** *Allium cepa*, Antidiabetic, Antioxidant, Folklore medicine, Onion

Onion (*Allium cepa* L.), a bulbous vegetable and condiment crop, is one of the important crops which has been domesticated and cultivated in the old world for more than 5000 years due to their peculiar properties as food, therapeutic value and ethnopharmacological properties. This crop is grown worldwide in almost all climates (Khar *et al.* 2020, Singh *et al.* 2021). Many taxonomists suggested that this crop originated in Turkmenia, Uzbekistan, Iran, Pakistan, Afghanistan and India, and possessed widely distributed genetic diversity geographically, and diverse climatic conditions from temperate to tropical regions (Singh *et al.* 2021). Temperature and photoperiod are the critical factors for the bulb development and overall performance of the crop. With the agricultural advancement, public sector breeders have developed and released various high yielding open pollinated varieties from heterogenous populations or landraces by taking care of consumer preferences and fitting the prevailing climatic conditions.

Since antiquity, India is known for *Rishi* and *Krishi*. For various health ailments, lots of traditional plant-based

remedies are being exploited and passed on from generation to generation. It can be said that India has established heritage and traditional knowledge (TK) of herb-based medicines. Such indigenous knowledge and practices are the best assets of any specific locality, region or ethnic group, religion, etc. Indian literature revealed the medicinal values of onion in '*Palandukalp*' as its bulbs are useful for human health, stout and energetic, sweet voice and lustrous skin (Singh 2017, Kolekar *et al.* 2021). This bulbous crop is cultivated across the globe, its plants displayed a great genetic and morphological diversity including colour, shape, pungency, dry matter content and other biochemical parameters. Such huge diversity is the reflection of a broad spectrum of adaptability to the range of climatic conditions of the *Allium cepa* species.

Every community, region and country have its various traditional and folk remedies but there is a great need to document them in a systematic way so that they could be the foundation of more scientific and modern research on that particular aspect. Being the oldest and earliest domesticated crop, onion biochemicals are playing an utmost role in the maintenance of physical well-being of mankind and animals (Ali *et al.* 2000). Singly or in combination with other herbs, onion is used to prevent the seasonal ailments and other

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health problems. From that traditional knowledge, modern scientists evaluated its medicinal properties and established the epitomized beneficial properties in the 21<sup>st</sup> century (Block 1992, Gulsen and Ayaz 2010, Cazzola *et al.* 2011, Suleria *et al.* 2013, Arshad *et al.* 2017). The World Health Organization also endorses the use of fresh onion extracts for treating colds, coughs, bronchitis, asthma, appetite loss, relieving hoarseness and preventing atherosclerosis (Jain *et al.* 2019). Because it naturally possesses higher amounts of flavonoids and is widely popular across the world, the onion crop becomes an interesting and fascinating vegetable (Griffiths *et al.* 2002). On the contrary, excessive consumption of onion causes flatulence and coughing (Sairam 1998). They are also recommended to lighten blood and lymph stagnation. Regularly taking on an empty stomach of a mixture of white onion and honey was considered an exceptional aphrodisiac tonic (Nibodhi 2010, Suleria *et al.* 2013, Verotta *et al.* 2015).

Most of the breeding experiments focused only on enhancing yield and yield attributing components, however, little focus has been given to improving various quality characteristics. In Indian onion, not much scientific data on genetic variability, heritability and trait association of various phytochemical contents, antioxidant activity and bulb traits are available (Islam *et al.* 2019). As intensive research work is needed on onion bulbs and their constituent biochemical compounds, it is only probable that scientific evidence will appear to validate their distinction in traditional and folklore remedies in various cultures across the globe.

#### *Consumption Pattern in India*

Being versatile and accepted by all except a few communities, onion is an integral part of the human diet since antiquity. No cuisine is complete without onion flavour and aroma. It is a king in Punjabi and Sindhi cuisines. The onion market is gaining popularity day by day and it has been available in an array of processed forms such as canned, pickled, paste and powder form (Singh *et al.* 2021). India, being an agriculture-based country, is at 2<sup>nd</sup> rank in production after China as a major cash crop. In India, onion processing industry is developing at a faster pace because of fluctuation and price crisis in the past. The onion chutney, soup and pickles in vinegar are the most preferred and delicious items in India. With this, more specific and focused research has been planned and funded. On the contrary, genetic improvement studies in onion are cumbersome due to its high out-crossing nature, flower structure, inbreeding depression, biennial nature, maintenance of long isolation distance for genetic purity of seed, high sensitivity to environment, etc (Khar and Singh 2020).

National Horticultural Research and Development Foundation (NHRDF) surveyed 12 major Indian states to estimate the daily consumption of onion. The highest consumption per capita per day of onion was recorded in Punjab (56.58 g) followed by Himachal Pradesh (55.93 g) and Haryana (51.34 g), while the lowest was documented in Tamil Nadu (37.68 g), Delhi (40.82 g) and Bihar (41.71 g).

The national average was calculated as 45.63 g. Only 1.14% was lower in the rural areas compared to the national average consumption. While in cities, 2.58% higher consumption was recorded than the national average. It was noticeable that consumption in the urban areas of Uttar Pradesh and Andhra Pradesh was lower than in rural areas. Hilly state Himachal Pradesh has been recorded as the least onion producing state (Bhaskar *et al.* 2018). To enhance the productivity of onion in India, there is a prerequisite to develop climate resilient smart cultivars and F<sub>1</sub> hybrids to counter various biotic and abiotic stresses under rapidly changing climate conditions and ensure food and nutritional securities (Singh *et al.* 2020, Khar *et al.* 2020).

#### *Historical aspects*

For the discoveries of new drugs, research on potential medicinal plants has always been considered to be an essential and basic approach (Elisabetsky 1991). Therefore, it is of utmost necessity to have indigenous knowledge about that particular species to initiate further research on its pharmacological potential and activities in the laboratories. Customarily, *Allium* species specifically onion and garlic, have been exploited for centuries in Asian, European and North American folklore medicines for the treatment of various health issues. Nevertheless, with the advancement, notable progress is evident to study their mode of action. Various medicinal and food values of onion were well documented in the *Garuda Purana* by the great Indian sage Atreya (Kameshwari 2013). Furthermore, Ayurvedic science contemplates this bulbous crop as multipurpose and versatile for heart diseases, diabetes, promoting expectoration and decline of phlegm (Bakhru 1993, Verotta *et al.* 2015, Kapoor 2018). As mentioned in *Susruta Samhita* and *Charaka Samhita*, the use of onion provides strength and increases immunity. Besides this, *Yogi Bhajan* reiterates the therapeutical significance of the combination of onion, garlic and ginger which is known as trinity roots (Khalsa and Tierra 2010). With the awareness among the masses, the demand for healthy and nutritious foodstuff is highly augmenting the intake of various fruits and vegetables. Onion bulbs have long been a key source of various dietary phytochemicals and nutrients having health promoting assets which are necessarily required to protect the human body from various diseases and disorders.

#### *Quercetin-a magical biochemical*

In onion, the presence of substantial amounts of quercetin (a flavonoid) made this crop more special and augmented its utility as an ethnomedicine and modern functional superfood (Ly *et al.* 2005). Quercetin is a potent antioxidant flavonoid that is present near the skin of bulb which may protect against heart disease and cancer. This useful bio-compound tends to be more concentrated in the outer layers of bulb. Therefore, onion's outer layers are more important to get maximum health benefits. Hence less peeling off on onion bulb is suggested. Significant variation in the phytochemicals amount among varieties/

genotypes, stage of maturity and storage had been well documented. Concentrations of various bio-compounds and phytochemicals varied with genotype and colour of onion bulbs. Even storage conditions and geographical location also influence the amount of quercetin flavonoid. White onion bulbs possess only a lower concentration of flavonols while red-, pink- and yellow-coloured bulbs exhibited more quercetin concentration (Patil *et al.* 1995).

#### Traditional uses as medicine

The bulbous onion contains almost similar properties to garlic but in a lesser amount. In ancient literature, there are well documented uses of onion. Having great nutritive value and also possessing various medicinal properties as folk medicine, it is used to cure cough, cold, asthma and so on (Block 1992, Gulsen and Ayaz 2010, Cazzola *et al.* 2011, Suleria *et al.* 2013, Arshad *et al.* 2017). Onion is a good source of essential amino acids such as methionine, cysteine, glutamine and isoleucine (Gulsen and Ayaz 2010), strong immunity and cardiovascular system and anti-asthmatic properties (Stajner and Varga 2003, Arshad *et al.* 2017). According to traditional medical literature, onions are a source of many vitamins and are useful in fever, dropsy and

chronic bronchitis. For colic, onions with common salt are used as a domestic remedy. Onion has an antiseptic value throughout the alimentary canal and onion tea is suggested for cholera, headache, fever and dysentery (Ali *et al.* 2000, Nadkarni 2002).

Asthma, fever, cough, cold and sore throat: Onion juice displays well documented anti-asthmatic properties (Stajner and Varga 2003). In the literature, juice of onion is used for relieving and preventing bleed of nose and infection of throat. Verotta *et al.* (2015) mentioned that taking onions with black pepper gave remarkable relief from malarial fever. The mixture of an equal amount of onion juice and honey (Bakhr 1993, Kapoor 2018) and the mixture of juices of onion, lemon and mint were found best and cheap remedies for curing cough. Consumption of raw onion or its juice with salt was used to treat tuberculosis by deactivating the causing bacteria. As a rich source of iron, onions are recommended to enhance blood haemoglobin. Crushing onions and inhaling the vapours during crushing were suggested as a traditional medicine for treating sore throat, cough, respiratory diseases and infections of the lungs. Similarly, licking of honey and onion juice combination was proposed to get relief from asthmatic cough. Subsequently, the combination of

Table 1 Potential therapeutic and medicinal uses of onion

Therapeutic and medicinal purpose	Reference
Antiparasitic properties against <i>Cryptosporidium parvum</i> , <i>Giardia</i> , <i>Entamoeba gingivalis</i> , <i>Leishmaniasis spp</i> , <i>Trichomonas vaginalis</i> , <i>Blastocystis hominis</i> etc	Cheraghipour <i>et al.</i> 2019
Cosmetic purposes. Also beneficial for acne, blackheads, burns and pimples. Onion also possessed anti-inflammatory, antimicrobial and antiallergic effects	Aburjai and Natsheh 2003
For treating hypertension/high blood pressure and regulating autonomic functions of the body	Alare <i>et al.</i> 2020
Antimicrobial, antitumor, antithrombotic, hypoglycaemic, hypolipidemic, antiarthritic properties	Ali <i>et al.</i> 2000
Source of Vitamin C as antioxidant and immunity booster	Singh <i>et al.</i> 2022
Onion juice for treating earache and running ears	Brooks 1986
Onion bulbs used as folk medicine to cure cough, cold, flu, asthma and sour throat	Block 1992, Gulsen and Ayaz 2010, Cazzola <i>et al.</i> 2011, Suleria <i>et al.</i> 2013, Verotta <i>et al.</i> 2015, Arshad <i>et al.</i> 2017
Boosting immunity and anti-asthmatic properties	Stajner and Varga 2003, Arshad <i>et al.</i> 2017
Curing of stomach pain, remove stomach gas and bloating	Bhaskar <i>et al.</i> 2018
For preventing intestine obstructions, gastrointestinal infections, nausea and constipation	Kapoor 2018, Nabavi <i>et al.</i> 2019
For hair falls and baldness	Brooks 1986, Dweck 1997, Bhil <i>et al.</i> 2020, Kolekar <i>et al.</i> 2021
Use of onion juice for curing colic in infants	Verotta <i>et al.</i> 2015
For treating jaundice in children	Nadkarni 2002
Improving sexual debility/weakness	Nibodhi 2010
Onion as an exceptional aphrodisiac tonic	Gupta and Bhaskar 2020
Toothache and kills off germs in the oral cavity	Dorant <i>et al.</i> 1996, Kim 1997
For getting relief from piles and haemorrhoids	Nadkarni 2002, Kapoor 2018
Anticancer properties	Challier <i>et al.</i> 1998, Calucci <i>et al.</i> 2003, Arshad <i>et al.</i> 2017
Anticlotting properties	Kendler 1987, Kleijnen 1989

white onion juice mixed with turmeric powder and little jaggery is found very useful for cough and sore throat when taken in the morning and evening time. For running nose and sneezing, consumption of fresh onions and their juices is used normally in Indian villages. Onions are also suggested to enhance appetite and improve digestion and digestive system, liver and spleen functioning, while also recommended to relieve stomach pain, remove stomach gas and bloating (Bhaskar *et al.* 2018). For chest infection, the mixture of onion juice, ginger and honey has been used as folklore medicine in India (Verotta *et al.* 2015).

**Headache, earache and pain reliever:** The anti-inflammatory effect of onion is due to the presence of isothiocyanates, quercetin and vitamin C. For headaches caused due to sunstroke, application of ground onions on the soles of the feet is used by people for centuries. Mixture of onion juice and mustard is used over painful joints, for skin diseases and inflammatory swelling (Kapoor 2018). For aching ears, people used warm onion juice and usually they put a few drops of warm onion juice by squeezing it into the ears. Some people used a mixture of red onions and oil of roasted almonds to treat deafness (Brooks 1986). For treating ear pain, whistling sounds and pus, putting a few drops of warm juice of onion in the ear is a folklore remedy for centuries (Brewster and Rabibowitch 1990).

**Digestive system:** Onion juice is recommended to kill worms and calm stomach ache and heartburn (Kumar *et al.* 2010). The mixture of juices of red onion and lemon helps to relieve dyspepsia. For bloody stools, dysentery and mucus, old people use finely cut onion pieces and freshly made curd from cow's milk to treat these ailments as a traditional remedy. Some communities put ground onions on the navel to control loose motions, while consumption of juice of onion is used to reduce the adverse effects of intoxicating drinks. Furthermore, for acidity problems, a mixture of small pieces of white onion and curd was found highly useful. Mixing of an equal amount of onion and ginger juices is used to get relief from vomiting. Additionally, for severe indigestion problems, a mixture of onion and bitter melon juice is considered the best folk remedy (Verotta *et al.* 2015). Fresh and cooked onions are highly recommended as a folklore medicine to prevent intestine obstructions; anus prolapse, gastrointestinal infections, amenorrhea, tuberculosis regurgitation, nausea and constipation and as a sedative (Kapoor 2018, Nabavi *et al.* 2019).

**Hair falls and baldness:** Some communities used a mixture of juice of red onions and oil of roasted almonds to cure baldness (Brooks 1986). African people used onion juice for burns and scalds to prevent infection and blistering, whereas onion skin is used for treating sores (Dweck 1997). Regular massage of onion juice on the bald areas enhanced the growth of new hair and reduced hair fall also. Even grinding onion and applying it to hair, turns hair black in colour. Onion bulbs, being an enriched source of vitamin C, helped to build and maintain collagen which is of great help to give structure to hair and skin (Bhil *et al.* 2020, Kolekar *et al.* 2021).

**Children health:** Onions along with jaggery are used to stimulate the growth and development of the children. Colic which is a common problem among infants and small children can be prevented by taking a mixture of onion juice with common salt (Verotta *et al.* 2015). Consumption of onion is also used to treat jaundice (Nadkarni 2002). Preparation of *kichadi* using onion, coconut and fenugreek helps to elevate breast-milk levels (Verotta *et al.* 2015).

**Sexual Debility:** Onions are recommended to lighten blood and lymph stagnation and to improve sexual debility/weakness (Nibodhi 2010). Regularly taking a mixture of white onion and honey on an empty stomach is considered an exceptional aphrodisiac tonic (Gupta and Bhaskar 2020).

**Insomnia and hypertension:** Bulbous onions are a good folk medicine to treat hypertension and activation of the autonomic nervous system (Alare *et al.* 2020). Drinking raw or boiled juice of red onions improves sleep and reduces insomnia.

**Nervous system:** Traditionally, a mixture of onion juice and water is used for fits when taken regularly during the morning time (empty stomach) for at least 40 days, whereas during fit it brings the person back to consciousness after smelling onion juice. Onion is being used to treat various neurodegenerative disorders (Sanderson *et al.* 1999).

**Cardiovascular diseases and heart attacks:** Among vegetables, bulbous onion crop is one of the few crops that reduce cardiovascular diseases and risk of heart attacks. Consumption of dietary onion is suggested to lower blood pressure, cholesterol and triglyceride levels and enhances HDL amount that helps to reduce heart related diseases, atherosclerosis, strokes and diabetes. Being a source of vitamin B6, onion helps to lower homocysteine level which is a responsible risk factor for heart strokes. Consuming an ample amount of fried or boiled onions in the breakfast helps to prevent heart diseases and formation of blood clots in the arteries, and daily consumption of one raw onion with a diet helps to regulate blood circulation system (Slimestad *et al.* 2007).

**Kidney disorders:** In traditional medicine, onions were explored to treat kidney disorders for decades. Taking syrup made from onion juice and sugar was used for the removal and reduction of kidney stones. In another way, drinking 50 gm of fresh onion juice on the empty stomach is advised for relieving and breaking kidney stones. For urinary issues, people used to boil 50 gm onion bulb pieces in 1 litre of water, after straining this water adding some amount of honey, taken thrice a day is quite useful for bringing on urine without any pain. Besides this, it is also used to reduce frequent urination problems (Bhaskar *et al.* 2018).

**Toothache:** Onion possesses strong antibacterial and antifungal properties, consumption of masticated one raw onion daily protects from various tooth disorders, especially toothache and kills off germs in the oral cavity (Dorant *et al.* 1996, Kim 1997).

**Piles/Haemorrhoids:** A mixture of roasted onions, cumin, cow's ghee and sugar is a home remedy used for getting relief from piles (Nadkarni 2002). Onion juice

along with sugar is used traditionally for relieving piles (Kapoor 2018).

**Anticlotting properties:** Onions are considered natural anti-clotting agent because they possess fibrinolytic activities and enriched sources of sulphur compounds which suppress the aggregation of platelet (Kendler 1987, Kleijnen 1989).

**Anticancer potential:** The risk of colorectal, laryngeal and ovarian cancers gets reduced by adding reasonable amounts of onion to the diet. The presence of a higher amount of fructo-oligosaccharide stimulates the healthy bacteria and suppresses the harmful in the colon region. Onion sulphides extracts exhibited protection against the growth of tumours in the colon and stomach. Further, enriching onion bulbs with antioxidants and phytochemicals such as terpenoids, carotenoids, flavonoids, vitamins, phytoestrogens and minerals are helpful to counter free radicals and various cancer types (Challier *et al.* 1998, Calucci *et al.* 2003, Singh *et al.* 2022). There is a strong inverse relationship between higher consumption of onions and the risk of occurring cancer (Arshad *et al.* 2017).

#### *Uses of onion seeds*

In various Indian dishes, seeds of onion are also consumed. Unlike bulbs, seeds do not make bad breath. Seeds of red onion possessed higher content of oil (20.4%), crude protein (24.8%) and fibre (22.4%). Besides this, seeds were also found enriched with potassium (1010 mg/100 g) and calcium (175.0 mg/100 g) while lower in sodium (11.2 mg/100 g) content. The presence of 6 cysteine derivatives utmost importance for treating obesity since such derivatives enhance glycemic control leading to reduction in intake of food and inducing adipose tissue cell death (Dini *et al.* 2008).

**Religious aloofness and side effects:** Excessive consumption of onion causes flatulence and coughing (Sairam 1998). Being a *rajasic* and aphrodisiac properties of onion bulbs, monks during yoga and meditation practices and *brahmana*-style cooking in India usually avoided consuming onions (Verotta *et al.* 2015).

#### *Miscellaneous uses*

For bone health, onion consumption of 1 gm per day per kilogram of body weight inhibits bone resorption by about 20% (Jaime *et al.* 2001). As an emollient, crushed onion is also recommended to cure the insect- and dog-bites, and skin diseases. Further, due to stimulant, expectorant, diuretic and emmenagogue properties, onion is preferred to be consumed raw (Kapoor 2018, Nadkarni 2002). For enhancing physical strength, taking a mixture of one teaspoon of onion juice and two teaspoons of honey daily is advisable. Red onions have been used traditionally for their beneficial effects in treating acne, boils, abscesses and blackheads for reducing inflammation and rapid healing (Aburjai and Natsheh 2003).

#### *Medicinal properties of onion waste*

The skin of onion attributes and contributes to waste during onion processing. Globally several research reports revealed the skin of onion as an enriched source

of antioxidants, fructooligosaccharides, polyphenols and dietary fibres. Apart from these properties, extract of onion skin has been documented as an hypocholesterolemic, good cardiovascular agent, anticarcinogenic, and having an antiasthmatic property. The powdered form of onion skin might be utilized for fortification into various food items such as bread and bakery products to provide various health benefits as these items are consumed intensively among the Indian people. Onion waste especially its skin has the nutraceutical and functional potential for use as an ingredient in food items (Sagar *et al.* 2021). Physicochemical analysis of the onion skin of commercial 15-short day Indian cultivars was carried out. The skin of 'NHRDF Red' possessed maximum fibre, ash content and protein among all the 15 cultivars, while cultivars 'Pusa Red' and 'Pusa Riddhi' exhibited the best source of fat and carbohydrates. Mineral and sulphur content were found maximum in OSP. The FTIR (Fourier Transform Infrared Spectroscopy) analysis displayed that all the onion commercial cultivars possessed various functional groups, such as aromatic ring, carbohydrate, methylene in the saturated aliphatic group and sulphur oxy-compounds (Sagar *et al.* 2021).

#### *Future prospective*

A paradigm shift occurred in the latter half of the 20<sup>th</sup> century from traditional and folklore medicinal practices toward synthetic chemical drugs. With this shift, there was an immense loss of information and knowledge regarding their uses and efficacy. With the awareness regarding use of herbs for various ailments, nowadays people have evinced interest in plant-based products and remedies to avoid the side effects of synthetic drugs for various health issues such as allergies, headaches, arthritis, insomnia, anxiety and depression (Eisenberg *et al.* 1993, Craig 1999). Onions are an enriched source of quercetin and kaempferol and both possessed higher antioxidant properties. Such strong antioxidative properties of onion bulb consumption have been well documented for the reduction in the risk of cataract formation, neurodegenerative disorders, various kinds of cancer, ulcer development and prevention of cardiovascular and other heart diseases by reducing cholesterol levels, especially low-density lipoprotein (LDL). It can be recommended that the utilization of plant-based nutraceuticals is better than devouring synthetic drugs against known and specific diseases. Being both ancient and modern medical science, a lot of scientific efforts are needed to dig out the exemplified health benefiting properties. For enhancing Indian short day onion productivity, there is a need of the hour to develop well adapted F<sub>1</sub> hybrids having high quality and enrichment of phytochemicals to ensure nutritional and food security (Singh and Khar 2021).

#### *Conclusion*

With the upsurging and advancement of modern nutrition science, prevention of various diseases and other health issues through consumption of various vegetable crops are exploited exponentially because of their chemical

properties in the form of high levels of antioxidants, vitamin C, anthocyanins and flavonoids. Onion has fitted well for this purpose for the centuries. It is grown globally for cooking, raw consumption and therapeutic purposes. As an enriched source of polyphenols, thiosulfates, flavonoids, dietary fibre, onion acts as an anticancer, antidiabetic, antimicrobial, cardiovascular and strong antioxidant properties. Due to the burgeoning population, rising of new diseases, escalated healthcare expenses, awareness of quality life and good health, we have to focus on phytonutrients and widely accepted plants or herbs that have a long history of use for health maintenance like the onions. To dig out various nutritional and health-promoting properties of onion bulbs, especially of Indian varieties is the need of the hour. To orient future focused research on the onion, biochemical analysis of Indian germplasm should be undertaken on the priority and in a comprehensive way as future functional food and herbal medicines and cosmetics.

#### REFERENCES

- Aburjai T and Natsheh F M. 2003. Plants used in cosmetics. *Phytotherapy Research* **17**(9): 987–1000.
- Alare K, Alare T and Luviano N. 2020. Medicinal importance of garlic and onions on autonomic nervous system. *Clinical Pharmacology Biopharmaceutics* **9**(4): 1–4.
- Ali M, Thomson M and Afzal M. 2000. Garlic and onions: their effect on eicosanoid metabolism and its clinical relevance. *Prostaglandins, Leukotrienes and Essential Fatty Acids* **62**(2): 55–73.
- Arshad M S, Sohaib M, Nadeem M, Saeed F, Imran A, Javed A, Amjad Z and Batool S M. 2017. Status and trends of nutraceuticals from onion and onion by-products: A critical review. *Cogent Food and Agriculture* **3**(1): <https://doi.org/10.1080/23311932.2017.1280254>
- Bakhru H K. 1993. *Herbs that Heal*, pp. 132–36. Orient Paperbacks, Delhi, India.
- Bhaskar P, Tailor A K, Sharma H P, Singh R K and Gupta P K. 2018. Medicinal, nutraceutical values and consumption pattern of onion (*Allium cepa*) in India: An Overview, *Intentional Journal of Current Microbiology Applied Science* **6**: 2629–38.
- Bhil M M S, Bhamare M M B, Jadhav M P T, Borse M J C and Chaudhari M V A. 2020. Formulation and evaluation of hair setting gel by using onion oil, *baheda*. *International Journal of All Research Writings* **3**(1): 91–99.
- Block E 1992. The organosulfur chemistry of the genus *Allium*. Implications for organic sulfur chemistry. *Agnewandte Chemie International Edition in English* **31**: 1135–78.
- Brewster J L and Rabibowitch H D. 1990. *Onions and Allied Crops: Biochemistry, Food*, Vol. 3.
- Brooks D. 1986. An onion in your ear. *The Journal of Laryngology and Otology* **100**(9): 1043–46.
- Calucci L, Pinzino C, Zandomenighi M and Capocchi A. 2003. Effects of gamma-irradiation on the free radical and antioxidant contents in nine aromatic herbs and spices. *Journal of Agricultural and Food Chemistry* **51**: 927–93.
- Cazzola R, Camerotto C and Cestaro B. 2011. Anti-oxidant, anti-glycant, and inhibitory activity against  $\alpha$ -amylase and  $\alpha$ -glucosidase of selected spices and culinary herbs. *International Journal of Food Sciences and Nutrition* **62**: 175–84.
- Challier B, Pernau J and Viel J. 1998. Garlic, onion and cereal fibre as protective for breast cancer: A French case study. *European Journal of Epidemiology* **14**: 739–47.
- Cheraghipour K, Marzban A, Ezatpour B, Moradpour K and Nazarabad V H. 2019. The role of onion (*Allium cepa*) in controlling parasitic diseases: a mini review. *Herbal Medicines Journal* **4**: 175–80.
- Craig W J. 1999. Health-promoting properties of common herbs. *The American Journal of Clinical Nutrition* **70**(3): 491–99.
- Dini I, Tenore G C and Dini A. 2008. Chemical composition, nutritional value and antioxidant properties of *Allium cepa* L. var. *tropeana* (red onion) seeds. *Food Chemistry* **107**(2): 613–21.
- Dorant E V D B, Van den Brandt P A, Goldbohm R A and Sturmans F E R D. 1996. Consumption of onions and a reduced risk of stomach carcinoma. *Gastroenterology* **110**(1): 12–20.
- Dweck A C. 1997. Indian plants. *Cosmet Toiletries* **112**: 37–51.
- Eisenberg D M, Kessler R C, Foster C, Norlock F E, Calkins D R and Delbanco T L. 1993. Unconventional medicine in the United States. Preference, costs and patterns of use. *New England Journal of Medicine* **328**: 246–52.
- Elisabetsky E. 1991. Socio-political, economical and ethical issues in medicinal plant research. *Journal of Ethnopharmacology* **32**(1-3): 235–39.
- Griffiths G, Trueman L, Crowther T, Thomas B and Smith B. 2002. Onions - A global benefit to health. *Phytotherapy Research* **16**: 603–15.
- Gulsen G and Ayaz E. 2010. Antimicrobial effect of onion (*Allium cepa*) and traditional medicine. *Journal of Animal and Veterinary Advances* **9**: 1680–93.
- Gupta P K and Bhaskar P. 2020. Medicinal Values: Onion and Garlic. 23<sup>rd</sup> Bulletin, Published by National Horticultural Research and Development Foundation, New Delhi.
- Islam S, Khar A, Singh S and Tomar B S. 2019. Variability, heritability and trait association studies for bulb and antioxidant traits in onion (*Allium cepa*) varieties. *Indian Journal of Agricultural Sciences* **89**(3): 450–57.
- Jaime L, Martín-Cabrejas M A, Molla E, Lopez-Andréu F J and Esteban R M. 2001. Effect of storage on fructan and fructo-oligosaccharide of onion (*Allium cepa* L.). *Journal of Agricultural and Food Chemistry* **49**(2): 982–88.
- Jain N, Sharma O P and Chaudhary P. 2019. Medicinal uses of Palandu (*Allium cepa* L.): A review article. *World Journal of Pharmaceutical and Medical Research* **5**(1): 188–91.
- Kameshwari M S. 2013. Chemical constituents of wild onion *Urginea indica* Kunth Liliaceae. *International Journal of Pharmacy and Life Sciences* **4**: 2414–20.
- Kapoor L D. 2018. *CRC Handbook of Ayurvedic Medicinal Plants*. CRC Press, Milton.
- Kendler B S. 1987. Garlic (*Allium sativum*) and onion (*Allium cepa*): a review of their relationship to cardiovascular disease. *Preventive Medicine* **16**: 670–85.
- Khalsa K P S and Tierra M. 2010. *The Way of Ayurvedic Herbs*, pp. 60–62. Motilal Banarsi Dass Publishers, Delhi, India.
- Khar A, Hirata S, Abdelrahman M, Shigyo M and Singh H. 2020. Breeding and genomic approaches for climate-resilient garlic. *Genomi Designing of Climate Smart Vegetable Crops*, pp. 359–83. Kale C (Eds). Springer, Switzerland.
- Khar A and Singh H. 2020. Rapid Methods for Onion Breeding. *Accelerated Plant Breeding*, Vol. 2, pp. 77–99. C Kole (Eds). Springer, Cham, Switzerland.
- Kim J H. 1997. Anti-bacterial action of onion (*Allium cepa* L.) extracts against oral pathogenic bacteria. *The Journal of Nihon*

- University School of Dentistry* **39**: 136–41.
- Kleijnen J, Knipschild P and Riet G T. 1989. Garlic, onions and cardiovascular risk factors. A review of the evidence from human experiments with emphasis on commercially available preparations. *British Journal of Clinical Pharmacology* **28**: 535–44.
- Kolekar Y S, Tamboli F A, More H N, Mulani S A and Mali N P. 2021. Medicinal plants used in cosmetics for skin and hair care. *International Journal of Pharmaceutical Chemistry and Analysis* **8**(2): 36–40.
- Kumar K S, Bhowmik D, Chiranjib B and Tiwari P. 2010. *Allium cepa*: A traditional medicinal herb and its health benefits. *Journal of Chemical and Pharmaceutical Research* **2**: 283–91.
- Ly T N, Chiharu H, Makoto S, Hiromune A, Koji K and Ryo Y. 2005. Antioxidative compounds from the outer scales of onion. *Journal of Agricultural and Food Chemistry* **53**: 8183–89.
- Nabavi S M, Suntar I, Barreca D and Khan H. 2019. *Phytonutrients in Food: From Traditional to Rational Usage*. Woodhead Publishing.
- Nadkarni K M. 2002. *Indian Materia Medica*, Vol. 1. Popular Prakashan, Mumbai, India.
- Nibodhi. 2010. *Annapurna's Prashad, Mata Amritanandamayo Mission Trust*, Amritapuri, India.
- Patil B S, Pike L M and Hamilton B K. 1995. Changes in quercetin concentration in onion (*Allium cepa* L.) owing to location, growth stage and soil type. *New Phytologist* **130**(3): 349–55.
- Sagar N A, Khar A, Tarafdar A and Pareek S. 2021. Physicochemical and thermal characteristics of onion skin from fifteen Indian cultivars for possible food applications. *Journal of Food Quality* Article ID 7178618, <https://doi.org/10.1155/2021/7178618>
- Sairam T V. 1998. *Home Remedies*, Vol. 1. Penguin Books, Delhi, India.
- Sanderson J, McLauchlan W and Williamson G. 1999. Quercetin inhibits hydrogen peroxide-induced oxidation of the rat lens. *Free Radical Biology and Medicine* **26**: 639–45.
- Singh A K. 2017. Early history of crop introductions into India: I. *Allium* (L.) spp. *Asian Agri-History* **21**(3): 301–05.
- Singh H, Verma P and Khar A. 2020. Heterosis breeding in onion for nutritional and food security. (In) *Proceedings of National Conference on Food Safety, Nutritional Security and Sustainability*, pp. 252.
- Singh H and Khar A. 2021. Perspectives of onion hybrid breeding in India: An overview. *The Indian Journal of Agricultural Sciences* **91**(10): 1426–32.
- Singh H, Khar A and Verma P. 2021. Induced mutagenesis for genetic improvement of *Allium* genetic resources: a comprehensive review. *Genetic Resources and Crop Evolution* **68**: 2669–90.
- Singh H, Verma P, Kumar A and Khar A. 2022. Screening of forty-five Indian short-day onion cultivars for Vitamin C content to ensure nutritional security. *Indian Journal of Horticulture* **79**: 160–67.
- Slimestad R, Fossen T and Vagen I M. 2007. Onions: A source of unique dietary flavonoids. *Journal of Agricultural and Food Chemistry* **55**: 10067–80.
- Stajner D and Varga I S. 2003. An evaluation of the antioxidant abilities of *Allium* species. *Acta Biologica Szegediensis* **47**: 103–06.
- Suleria H A R, Butt M S, Anjum F M, Saeed F and Khalid N. 2013. Onion: Nature protection against physiological threats. *Critical Reviews in Food Science and Nutrition* **55**: 50–66.
- Verotta L, Macchi M P and Venkata S P. 2015. Connecting Indian wisdom and western science. *Plant Usage for Nutrition and Health*, Vol. 15. CRC Press.