



## Review on Phytochemicals and Pharmacological Studies of *Allium cepa* (Onion)

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### ABSTRACT

In present days, herbal medicines have gained importance with both medical and economic implications. Throughout the world raised concerns of quality, safety and efficacy. Onion has been valued as a food, medicinal plant since ancient times and widely cultivated. And known as “Queen of the kitchen”. Due to its flavor, aroma, unique taste, medicinal properties of its compound. And acts as food which provides a good amount of nutrients, immunity to the body, helps in treating high cholesterol, diabetes, joint disorders, digestive ailments, loss of appetite, gallbladder diseases, angina pectoris, high blood pressure, atherosclerosis, sore throat, asthma, bronchitis, cough, intestinal gas and intestinal worms as therapeutic agent. Different biological properties, such as, antioxidants, anti-inflammatory, anti-cholesterol, antihypertensive, anti-cancer, anti-arthritis, anti-bacterial, bronchodilator, expectorant, anti-spasmodic, antiseptic, carminative, anti-coagulant, fibrinolytic, anti-helminthic, anti-platelet, hepatoprotective activity, anti-diabetic, anti-viral, cardiovascular protective, anti-microbial, neuro protective, anti-genotoxic and anti-mutagenic effect, anti-pyretic, analgesic, and various other biological activities. Wide spectrum of biological activities of onion makes it as a potential medicinal and therapeutic agent.

**Keywords:** *Allium cepa*, Pharmacological and therapeutic Activities.

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### INTRODUCTION

**A**. *cepa* (Onion) is used as a multipurpose food plant and as traditional Indian spices with great health significance. Onions are pungent when they are chopped and contains chemical substances which irritates the eyes<sup>1</sup>. Onion is consumed in order to obtain its putative nutritional along with health benefits, it has flavor, aroma, unique taste, medicinal properties called as “Queen of the kitchen” and using form centuries<sup>2,3</sup>. *Allium*, a huge genus carrying 4000 species. Disseminated throughout the temperate regions near the world. Including Europe, Asia, North America, Africa. The name arise in all probability was taken from the Latin *unus* which means as “one”. The Romans inaugurated the onion up to Britain, starting with where it may be conveyed to Americans<sup>4</sup>. The dignified physician Hippocrates advised onion as an emmenagogue, diuretic, laxative. Also used for the medication of healing putrid wounds, outer, also for pneumonia<sup>5</sup>. Other names for *Allium cepa* are in English as Onion, Tamil as Vaengayam, Malayalam as Savala, Telugu as Ullipayalu, Kannada as Ulligadde, Hindi and Punjabi as Payaz, Bengali as piyaz, Gujarati as Dungri, Konkani as Sawalo, Marathi as Kanda, Oriya as paja<sup>6</sup>. Onion is a

production, produced world widely and extensively grown biennial bulb crop. Production of onion in India 23,262 tons in 2017-18, and 23,610 tons in 2018 -19<sup>7</sup>. Onions used as a food stuff usually by cooking, or a part of prepared savory dish or as vegetable. However, it also eaten as raw in pickles and chutneys. The roots of onion bulb are used to treat the flatulence, diarrhoea, alleviate night blindness, urinary tract infections, it also relieves nausea, fever, cough, stimulate appetite, fortify semen, to alleviate urine blockages, phlegm, acts as diuretic, stimulant, and as an expectorant<sup>8</sup>.

*A. cepa* contains sugar, carbohydrates, water, proteins, vitamins, fiber, potassium, vitamin C, B6 and trace amount of mineral schromium, Onions require specific conditions for the optimal growth which include stone-free, loamy, sunlight, excellent drainage, well-irrigated soil<sup>9</sup> with significant amounts of nitrogen, phosphorus and potassium are required for maximum yield<sup>10</sup>. Nutritional value can vary with temperature which plays an important role in onion development as in hotter conditions more sulfur and pungent flavor will be produced, sulfate fertility in soil, water supply which plays a main role in determining pungency and flavor, variety, sulfate fertility in soil, storage, environmental conditions, and flavor of it is due to sulfur compounds developing throughout the season, growth of onion under dry conditions will increases the pungent flavors<sup>11</sup>. The plant was displayed in figure -1





**Figure 1:** Entire plant of *ALLIUM CEPA*

### Plant Profile of *Allium cepa*

Scientific Name: *Allium cepa*

Plant Family: Amaryllidaceae

English Name: Onion

Hindi Name: Palandu, piyaz

Other Names: Bulb Onion, Garden Onion, White Onion

Kingdom: Plantae

Subkingdom: Viridiplantae

Infra-Kingdom: Streptophyta (Land Plant)

Super Division: Embryophyta

Division: Tracheophyta (Vascular plants), Tracheophytes.

Sub division: Spermatophytina, Spermatophytes (seed plants).

Class: Magnoliopsida

Super Order: Liliales (Monocots, Monocotyledons, Monocotyledones)

Order: Asparagales

Genus: *Allium*

Species: *Allium cepa* L.

Vernacular names: Onion, Basal, basl, cebolla, cebolla morada, cepa bulb, cepolla, cipolla, common onion, cu hanh, hom hua yai, Spanish onion, tamanegi, umbi bawang merah, Madras onion, oignon, red globe onion, Zwiebel, yellow Bermuda onion, piyaj, piyaz, ralu lunu, sibuyas, luyon, etc.,

### Plant Description

It is a perennial or biennial plant, grows up to 70cm in both warm and cold climates, all types of soil vary from dry to moist and mineral based soils and geographically distributed in South West Asia. Shoots, seeds and bulbs are used for medicinal purpose, the roots are small and shallow roots, stems (up to 100cm tall&30mm diameter, tapering from inflated lower part) are stiff and erect, flowers are white to pink on the top of stem, seeds are black and small, bulb size (up to 20 cm in diameter), white or colored and shape (depressed-globose) may vary from cultivar to cultivar, leaves are bluish-green up to 40cm

(height), 20mm (diameter). Umbel 4-9cm (diameter) hemispherical, dense and many flowered. Pedicels 40mm and equal, filaments 4-5mm outer subulate, inner expanded base nearly 2mm wide, short teeth in each side, stamens are exerted. Ovary is whitish and the capsule is about 5mm<sup>12, 13, 14</sup>. The parts of *A. cepa* are listed in the below fig -2



**Figure 2:** Parts of *Allium cepa*

a. Umbel with Seeds, b. Flower, c. Stem and Leaves, d. Bulbs

### Microscopic Characters

The dried leaf scales of the bulbs consist a large-celled epidermis, lightly spotted cell walls, cells (elongated longitudinally), underlying hypodermis runs perpendicular to epidermis with large calcium oxalate crystals along the cell walls. For fresh leaf scales are same as dried leaf, epidermal cells dorsal side, distinctly longer, more elongated than ventral side epidermal cells, large calcium oxalate crystals in hypodermis, rare stomata, in leaf mesophyll spiral vessel elements are present and large cell nuclei<sup>15</sup>

### Chemical Constituents

*A. cepa* principal constituent is an important oil containing more amount of mono, di, tri, tetra-sulphides, thiophene and thiols derivatives. Bulbs and leaves of onion consist of huge number of cyaniding glycosides, prostaglandins, quercetin, other flavonoids, sterols, phenol compounds, catechol, protocatechuic acid are present in dry brown outer scale, diosgenin in flowers and bulbs<sup>16</sup>. Onions also contain selenium<sup>17</sup>, quercetin<sup>18</sup>, flavonols<sup>19</sup>, S-alk(en)yl cysteine sulfoxides<sup>20</sup>, flavonoids, allylsulfides<sup>21, 22</sup>, organosulfur compounds<sup>23</sup>, thiosulfates<sup>24</sup>, cycloallin<sup>25</sup>, fructose, quercetin-3-glucoside and isohamnetin-4-glucoside<sup>26</sup>, sulfur and seleno compounds<sup>27</sup>, sulfates, xylose, galactose, glucose and mannose<sup>28,29</sup>.

### Pharmacological Activities

#### a) Antibiotic activity

Onion exhibit antibiotic activity against both Gram-positive and Gram-negative bacteria<sup>30</sup>. The fresh raw extracts of *Allium cepa* possess significant antibacterial potency against the bacteria's which are resistant for antibiotic

drugs<sup>31</sup>. Onion extracts are shown the antibacterial activity against the organisms used in the test<sup>32</sup>.

#### b) Antiviral activity

Onion and garlic consist huge amount of organosulphur compounds like quercetin, allicin which inhibits the viral infection and impart antiviral property<sup>33</sup>. By studying the molecular docking of that main protease of COVID-19 by the natural compounds are found in garlic and onion these can be used as a powerful prohibitors opposing the main protease of COVID-19<sup>34</sup>.

#### c) Antioxidant activity

Aqueous extract of *Allium cepa* antioxidant activity<sup>35</sup>. *Allium cepa* red and white varieties showed antioxidant activities<sup>36</sup>. Quercetin-3'-O-beta-D-glucoside isolated from *Allium cepa* antioxidant activities<sup>37</sup>. Onion flesh and onion peel enhance antioxidant status in aged rats<sup>38</sup>. Antidiabetic and antioxidant effects of S-methyl cysteine sulfoxide isolated from onions (*A. cepa* Linn.) as compared to standard drugs in alloxan diabetic rats<sup>39</sup>. Dietary flavonols protect diabetic human lymphocytes against oxidative damage to DNA<sup>40</sup>.

#### d) Anti-cancer activity

Number of *in vitro*, animal, epidemiological studies indicate that onion extract or onion prevents cancer including gastrointestinal cancer, ovarian cancer, skin cancer<sup>41,42,43,44</sup>. Common current theory is that the metabolites of organosulfur, especially S-alk(en)yl cysteine sulfoxide, found in these herbs inhibits mutagenesis, incorporate phase two detoxification enzymes, influence cell arrest and apoptosis, scavenge free radicals and inhibit DNA adduct formation<sup>45,46</sup>.

#### e) Anti-inflammatory activity

Onion showing anti-inflammatory activity by the presence of quercetin. Onions showed antiasthmatic activity<sup>47</sup>. The natural product Ajoene is isolated from *Allium* shows anti-inflammatory properties<sup>48</sup>. The fistular onion stalk extract useful for the attenuation of atherosclerosis and the mechanism includes the regulation of the local inflammatory response<sup>49</sup>.

#### f) Antihyperlipidemic activity:

Onion derived sulfur compounds including S-methyl cysteine sulfoxide and allyl propyl disulphide<sup>50</sup>, showed hypolipidemic effects. These are established in rats and rabbits, lower down effects of diet-induced atherosclerosis, maintain hypolipidemic action, inhibitory effects on platelet formation<sup>51</sup>.

#### g) Anti-hypertensive activity

The hydroalcoholic extract of onion peel hypotensive effect by quercetin, anti-oxidant activity and as well as inhibition of Ca<sup>2+</sup> influx in vascular smooth muscle cells<sup>52</sup>. Hypertension study, using some rat models, has indicated that quercetin and its methylated metabolite isorhamnetin, found in onion, can reduce blood pressure

and prevent angiotensin- II-induced endothelial dysfunction by inhibiting the overexpression of p47phox, a regulatory subunit of the membrane NADPH oxidase. The subsequent increased superoxide production resulted in a high nitric oxide bioavailability<sup>53</sup>. Ethanolic extracts of onion and garlic in hypertensive rats reported that oral administration of extracts during a normal salt diet or during a high salt diet do not influence blood pressure<sup>54</sup>.

#### h) Anti-cancer activity

Consumption of *Allium* vegetables for prevention of different cancers<sup>55</sup>. Fisetin (3,7,3',4'-tetrahydroxyflavone) belongs to flavonol sub group of flavonoids together with quercetin, myricetin, kaempferol is found in several fruits and vegetables including apples, onions, strawberries and persimmons. Fisetin is natural agent that shows potential inhibitory role against cancer in several *in vitro* and *in vivo* studies<sup>56</sup>. *A. cepa* shows the presence of quercetin- 3'-O-beta-D-glucoside that display potent melanin biosynthesis inhibitory activity in B16 melanoma cells<sup>57</sup>. Ethanolic extract is used for the management of breast tumors<sup>58</sup>. Onion is good in controlling prostatic hypertrophy, endometrial, lung, gastrointestinal, breast related cancers<sup>59</sup>. Natural products present in onion cause alteration in carcinogen-metabolizing enzymes, cell cycle arrest, induction of apoptotic cell death, suppression of oncogenic signal transduction pathways and inhibition of neoangiogenesis<sup>60</sup>.

#### i) Anti-arthritis activity

Extract of onion skin showed the prevention of arthritis principal signs and reduces joint damage caused by CFA immune-mediate modulation monoarthritic arthritis induced in rats<sup>61</sup>.

#### j) Bronchodilator activity

By using ex-vitro and in-vivo assays the extract of red onion showed the bronchodilator activity in guinea pig and rat tracheal study<sup>62</sup>.

#### k) Anti-spasmodic activity

Flavonoid-rich hydro-acetone present in extract of red onion peel possess spasmodic activity<sup>62</sup>. Hydroalcoholic extract of onion peel consists of spasmodic effect on rat ileum<sup>63</sup>. High concentration of flavonoids and saponins present in red onion results anti-spasmodic activity<sup>64</sup>.

#### l) Expectorant activity

Onion consists of expectorant progenies and acts as expectorant<sup>65,66</sup>. Onion comprise pharmacological activity as an expectorant<sup>67</sup>.

#### m) Antiseptic activity

Phytochemicals present in the onion extract consists of anti-microbial activity against food borne pathogens *Escherichia coli* and *Staphylococcus Aureus*<sup>68</sup>.



**n) Anticoagulant activity**

Red onion aqueous extract has anticoagulant activity and had investigated by using the principles of prothrombin time test in In-vitro study <sup>69</sup>. Onion extract has anticoagulant property through prohibition of clot formation and coagulation process <sup>70</sup>. Extract of *Allium cepa* used in albino rat blood justified the anticoagulant activity of onion (*A. cepa*) <sup>71</sup>.

**o) Fibrinolytic activity**

Onion has confirmed the fibrinolytic activity by giving fat-enriched diet with and without onions in people <sup>72</sup>. Cycloallin which is present in onion administrated to post myocardial infraction people induced a significant increase in fibrinolysis after 15 h of medication <sup>73</sup>. In vitro study of the extracts of onion and garlic, onion has plasminogen activator which acts as fibrinolytic agent without proactivator <sup>74</sup>.

**p) Anti-helminthic activity**

Extracts of *A. cepa*, *A. sativum*, *Jatropha curcas* with water and ethanol in In vitro method against *Toxocara canis* and *Ancylostoma caninum*, onion extract has good anthelmintic activity by affecting the survival of larvae <sup>75</sup>.

**q) Anti-platelet activity**

Onion has antioxidant and antiplatelet activity and was observed by FC, TEAC, DPPH and Principal component analysis methods with people blood samples without medication for a week <sup>76</sup>.

**r) Anti-diabetic activity**

Soup of *A. cepa* is used for Type-2 diabetes mellitus controlling and also in other group life style diseases <sup>77</sup>. Red onion shows hypoglycemic effects of onion in Type-1 and 2 diabetic patients <sup>78</sup>. Dietary bulbs of onion showed antidiabetic effect in a high fat diet streptozotocin induced diabetes rodent model <sup>79,80,81</sup>. Onion has hypoglycemic effect in alloxan induced diabetic rats <sup>82</sup>. The potency of onion in Hypoglycaemic and antioxidant effects <sup>83</sup>.

**s) Anti-genotoxic and anti-mutagenic activity**

Onion has anti-genotoxic and anti-mutagenic activity <sup>84</sup>. Impact of ozonation on the genotoxic activity of tertiary treated municipal water reduced by onion <sup>85</sup>.

**t) Anti-pyretic activity**

Extract of fresh onion blubs on paracetamol and tetrachloride induced hepatotoxicity <sup>86</sup>. Genotoxicity induced by series of pharmaceutical compounds, metamizole sodium and acetylsalicylic acid toxicity, genotoxicity and cytotoxicity can cut down by onion [87][88][89].

**u) Analgesic activity**

Powder of onion has antidepressant like effect in behavioral model of depression in rat <sup>90</sup>. Inhibition of

chronic, acute pain and inflammation with fresh juice of onion and its strong effect towards inflammation <sup>91</sup>.

**v) Hepatoprotective activity**

Extracts of garlic and onion had potential towards hepatoprotective on cadmium-induced oxidative damage in rats <sup>92</sup>. Methanolic extract of onion has significant effect on hepatoprotective activity against paracetamol induced hepatotoxicity <sup>93</sup>.

**w) Neuroprotective activity**

Methanolic extract of outer scales, edible portion of *A. cepa* bulb when administrated to mice before cerebral ischemia and reperfusion exhibit notable neuroprotection by noticeably reducing cerebral infarct size, remarkable decreasing, increase in thiobarbituric acid reactive substances concentration in brain mitochondria, supernatant fractions and preventing global cerebral ischemia reduced impairment of motor coordination and short term memory <sup>94</sup>.

**CONCLUSION**

Now a days, onion has great importance and one of the magical foods, traditional medicinal plant due to its phytoconstituents and usable vegetable. Onion contains Sulphur compounds, glycosides, quercetin, flavonoids, phenol compounds, diosgenin, organosulfur compounds, S-alk(en)yl cysteine sulfoxides, cycloallin, allylsulfides, seleno compounds and sugar, water, carbohydrates, proteins, vitamins, fiber and potassium. Onion also contain compounds manifesting different therapeutic and pharmacological activities such as antioxidant, anti-inflammatory, anti-cholesterol, anti-hypertensive, anti-cancer, anti-arthritic, anti-bacterial, bronchodilator, anti-spasmodic, antiseptic, carminative, anti-coagulant, fibrinolytic, anti-helminthic, anti-platelet, anti-diabetic, anti-viral, cardiovascular protective, anti-microbial, hepatoprotective, neuroprotective, antigenotoxic, antimutagenic properties.

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