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Review Article

Traditional uses, phytochemistry and pharmacology of *allium cepa L*

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ABSTRACT

The common onion (Alliumcepa Linn), one of the earliest cultivated plants in the Liliaceae family, is used as a seasoning and vegetable in cooking around the world. It's an essential element in many parts of Africa. Egypt is the first country to grow abstinent, despite the fact that it is mostly manufactured there. In addition to several minerals, vitamins, and secondary metabolites such as phenolic acids, flavonoids, thiosulfinates, saponins, and phytosterols, it contains sulfur that contains amino acids. In addition to being primarily used as food, onions provide several other health benefits. Widespread pharmacological properties of onions, such as their antibacterial, antidiabetic, anticancer, and antioxidant cardiovascular effects, support their potential application in the treatment of a wide range of illnesses. The purpose of this review is to provide an overview of previous research on the beneficial benefits of this treatment on a number of co-morbidities, such as diabetes, obesity, hypertension, and hyperlipidemia.

1. Introduction

Garlic-scented bulbous herbs or onion is allium belonging to the family Amaryllidaceae. Various allium vegetables are consumed mainly as spices for their characteristic flavors and their health-improving effects, like leek (*Allium ampeloprasum var. porrum*) onion (*Allium cepa*), and garlic (*Allium sativum*).[1] Harvest yield of onion (*Allium cepa L.*), was 93.1 million tons in 2016 and is among the most widely consumed vegetables.[2] The word "onion" is originated from the Latin word 'unio' which means 'single' or 'one' as it yields a single bulb[3] It is a vegetable, also called the bulb onion or common onion that is cultivated for greater than 7000 years. The bulb shape is like a flattened globe or a globe, sometimes spindle-like or mostly cylindrical with a flat top.[4]

Different refines include onion juice concentrate, onion essential oil, dehydrated onion powder, and; are beneficial in flavoring and seasoning of foodstuffs.[5] Since ancient times, globally onion is the biggest economic graze and is used in medicine and food.[6–9] Geographical sources of onion are India the biggest cultivator, Turkey, China, Japan, USA Spain, Egypt, Poland and Brazil[10] and for Egypt, the yield is 2.4 million tons.[11] The plant onion is currently produced in 139 countries and has been cultivated for more than 4000 years.[12] After Americans (16 kg), Libyans utilize the maximum quantity of onion, for its worldwide consumption, and yield for a mean of 30 kg annually/capita.[13] Around, 13000 accessions of onion are kept in gene library globally with large gene variability in their physicochemical and morphological bulb traits such as weight, shape, scale color, flesh, dry matter content (DMC), firmness and pungency.[14] Onion cultivars are of

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Figure 1: Whole fresh bulbs of *Allium cepa Linn*.

three types: dehydrator types (>18% DMC), storage types (8 to 12% DMC) and fresh market types (5 to 9% DMC).[15] A characteristic odor of Allium species is because to the liberation of volatile organosulfur compounds on tissue destruction.[16] A species-specific pattern of S-alk(en)yl-cysteine sulfoxides (ACSOs) determines the aroma type of various Allium species.[17] The main predominant aromatic compound in onion is Isoalliin, along with slight amounts of propiin and methiin and traces of alliin.[18]

2. Chemical Constituents

Naturally, three subtypes of onion are reported; white, red and yellow. Generally, raw bulbs of onion have water (89%), sugar (4%), dietary fiber (2%), protein (1%,), traces of fat (~100 mg/100 g), and minor amounts of vital nutrients, irrespective of the subtype. Therefore, onion has an insignificant caloric value of (~40 kcal/100 g).[19]

Additionally, to ACSO and carbohydrates, onion bulbs have major gene diversity seen for their flavonoid content, that is reflected among others in various colors ranging from dark red and yellow to white. Flavonol couples with isorhamnetin, quercetin, and kaempferol as aglycones and almost solely β-D-glucosyl moieties in 4′-O, 3-O, and/or 7-O position are the predominating flavonoids in colored onions. Cyanidin and peonidin conjugates are present in Red scaled onions, but white-scaled onions lack flavonoids.[20] In colored onions, Cyanidin and Quercetin are the major predominant anthocyanidin and flavonol species, respectively. Yellow- and red-scaled cultivars have quantitative differences in flavonoid content were also found.[21,22] Sapogenins, saponins, flavonoids[23] & fructooligosaccharides (FOSs).[24] are known major components in *A. cepa*. Total flavonoids from onion a peel was concentrated by Li et al. got 90.25% flavonoids content extract.[25]

The external layer of the onion is a byproduct, a biological source with a high-value of various essential ingredients, and ought to be looked for different methods for their application.[26] The growth and yield of onion are increased with Indole acetic acid (IAA)-producing bacteria.[27] Spraying the extract of Spirulina, a herbicide, has a favorable effect on both chlorophylls a and b and carotene.[28] the plant biomass and height and elements of onion.[29]

Onions have been found to contain various phytochemicals[30,31] like quercetin glucosides, quercetin, kaempferol, thiosulfinates, anthocyanins, cepaenes and sulfur-containing compounds (e.g., S-allyl cysteine sulfoxide, methyl cysteine sulfoxide, dimethyl trisulfide, diallyl trisulfide) that affects human health.[32,33] Nowadays, onions have become a part of human food. The worldwide production of dried onion in China and India is 26% and 21% of the total global production, which is greater than 90 million tons.[34]

3. Uses

Since ancient times, onion has had a major role as a medicinal agent. This comprehensive health benefits are mainly due to organosulphur compounds which are a definite feature of garlic and all other Allium plants. There are some preservative correlations of onion and garlic in the treatment of cancers, especially cancers of the Gastrointestinal Tract, have been indicated by various studies since ancient times.[35]

To determine DNA destruction of each cell of pesticides, Root meristems of *Allium cepa* related comet assay have been widely used, because it is a completely simple, sensitive, reliable and relatively inexpensive technique when compared to various test systems and requires a small number of cells.[36–40] The *Allium cepa* test is also employed to govern the destructive effects of anaigenic and clastogenic chemicals because it is a very cheap and well-known method.[41–43] For the determination of clastogenicity of a compound, chromosomal aberration (ACs) and micronucleus (MN) tests are outstanding predictors, although mitotic index (MI) is also employed to detect the interferences in mitoticcell division.[44,45]

A perennial plant, Red onion (*Allium cepa L.*) with globe-like bulbs and opposite leaves which are originated from vast leaf bases enclosed in thin and dry skin,[46] is a major source of various phytonutrients. It has a typical pungent smell due to its sulfur-containing compounds and is a vital ingredient in kitchen dishes.[47] Onion is used as a folk medicine for numerous ailments like headaches, cardiovascular disease bites, tumors and worms.[48] *A.cepa* has been shown to possess many therapeutic activities like antioxidant,[49] anti-cancer[50], anticoagulant,[51] anti-diabetic,[52] and anti-inflammatory activities.[53]

Draelos reported that onion extract is useful in ameliorating the beauty aspect of post-operative scars[54]. Because of has vital health-promoting phytochemicals and nutrients, onion possesses high nutritional and therapeutic potentialities and is widely used for flavoring food formulations.[55,56] In addition, onion has been used as a potent therapeutic agent for the treatment of cancer, anemia, cardiovascular disease, teeth disorders, thrombolytic activity, fibrinolytic, blood pressure, urinary disorders, headache, bleeding piles, and cataract.[57–59] It is used as an herbal remedy for anthelmintic, carminative and aphrodisiac and as an herbal tonic for the curet of bronchitis, bruises, hypertension, diabetes and other respiratory disorders and jaundice[60,61]

Also, onion possesses antidiabetic, antioxidant, anti-ulcer, antihypercholesterolemiaplatelet anti-platelet, antibrowning properties, a good appetizer and food digester.[55,56,62,63] Onion has antioxidant properties due to the presence of organosulfur compounds and flavonoids[64]. Daily consumption of onion has been found to decrease the chance of various neurodegenerative, cardiovascular disorders and cancers because of a major amount of antioxidants and thus it is gaining more attention.[65]

4. Phytochemical Study

Upon extracting the external layer of *Allium cepa* with Methanolic hydroxide, a crude extract was found, and then it was screened with n-hexane, ethyl chloride, n-BuOH. 405g EtOAc fraction was segregated on silica gel and High-performance liquid chromatography. and new nine flavonoids were obtained which are cepaflavas A, cepaflavas B, cepadials A, cepadials B, cepadials C, cepadials D and cepabiflas A, cepabiflas B, cepabiflas C. Cepaflava A and B has molecular formula C19H18O9, is amorphous, pale yellow powder. Cepadials A, B and C were found has $C_{22}H_{14}O_{11}$ and $C_{23}H_{16}O_{11}$ as molecular formula respectively, and are amorphous brown powder. Cepadial D and Cepabifla A with molecular formula $C_{38}H_{24}O_{18}$ and $C_{36}H_{28}O_{19}$ respectively, are amorphous, bronze yellow powder. Cepabiflas B and C had a molecular formula of $C_{36}H_{28}O_{19}$, is an amorphous, bronze-yellow Powder.[26] The structures of six previously known compounds were identified in the previous studies, quercetin,[66] kaempferol[67], isorhamnetin,[68] quercetin 4'-O-β-D-glucopyranoside,[66] 1,3,11a-trihydroxy-9-(3,5,7-trihydroxy-4H-1-benzopyran-4-on-2-yl)-5a-[4-(β-D glucopyranosyloxy)-3-hydroxyphenyl]-5,6,11-hexahydro-5,6,11- trioxanaphthacene-12-one[69] and 1,3,11a-trihydroxy-9-(3,5,7-trihydroxy-4H-1-benzopyran-4-on-2-yl)-5a-[1,3,11a-trihydroxy-5a-(3,4-dihydroxyphenyl)-5,6,11-hexahydro-5,6,11-trioxanaphthacene-12-on-9-yl]-5,6,11-hexahydro-5,6,11-trioxanaphthacene-12-one (15).[70]

5. Pharmacological Activities of A cepa

Allium cepa is used as a potent medicinal agent and possesses antiviral, antibacterial, antiparasitic, antihypertensive, hypoglycemic, antifungal, antihyperlipidemic, and antioxidant, anti-inflammatory antiplatelet activity.

5.1. Antiplatelet activity

According to recent studies, the onion's pungency is linked to antiplatelet activity.[71] Sulfur compounds, chromium, and vitamin B6 all contribute to this. Platelet aggregation is also linked with atherosclerosis, cardiovascular disease, heart attack, and stroke.[72]

5.2. Antidiabetic activity

Onion is used in the cure of diabetes and its associated complications.[73,74] Onion soup is used to cure diabetes mellitus type 2 and other lifestyle diseases.[75] Onions have been reported to possess anti-diabetic properties because of the presence of allyl propyl disulfide, which raises free levels of insulin.[76] In alloxan diabetic rabbits allyl propyl disulfide increased glucose tolerance. Onion contains S methyl cysteine sulfoxide which is responsible for anti-diabetic activity.[77] Chromium improves glucose tolerance by decreasing insulin levels, fasting glucose levels, and lowering blood cholesterol and triglycerides (TG) levels.[78] Quercetin in *allium cepa* facilitates glucose-mediated secretion of insulin by assisting phosphorylation of extracellular signal-regulated kinase and protecting pancreatic beta-cells and ultimately controls sugar-induced secretion of insulin, elevating the specific activity of several pancreatic islets and liver glucokinase (a carbohydrate enzyme) that facilitates improved glucose tolerance.[79]

5.3. Anticancer Activity

The flavonoid quercetin contained in allium has been shown to have anticancer properties. It can stop cancer cells from growing. *Allium cepa L.* inhibits cancer cell proliferation and adipocyte proliferation by inhibiting the enzyme fatty acid synthase.[73] Ethanolic extract of this plant is beneficial for the treatment of breast tumors.[80] A flavonoid, Apigenin is found in onions, has shown to possess anticancer properties.[81] Sulfur compounds found in onions have been shown in studies to protect cells from mutation and induce apoptosis, preventing tumor growth and cancer production. In vitro studies show that onion extract inhibits mutagenesis/carcinogenesis,[82] modulates enzyme and cell signaling pathways,[83] scavenges free radicals,[73,84,85] induces apoptosis, and has immunomodulatory[86,87] and aaffects cell differentiation and cancer development.[88] The water leek extract of concentration (50 μg/Ml) was the most important anticancer effectwith a viability percentage

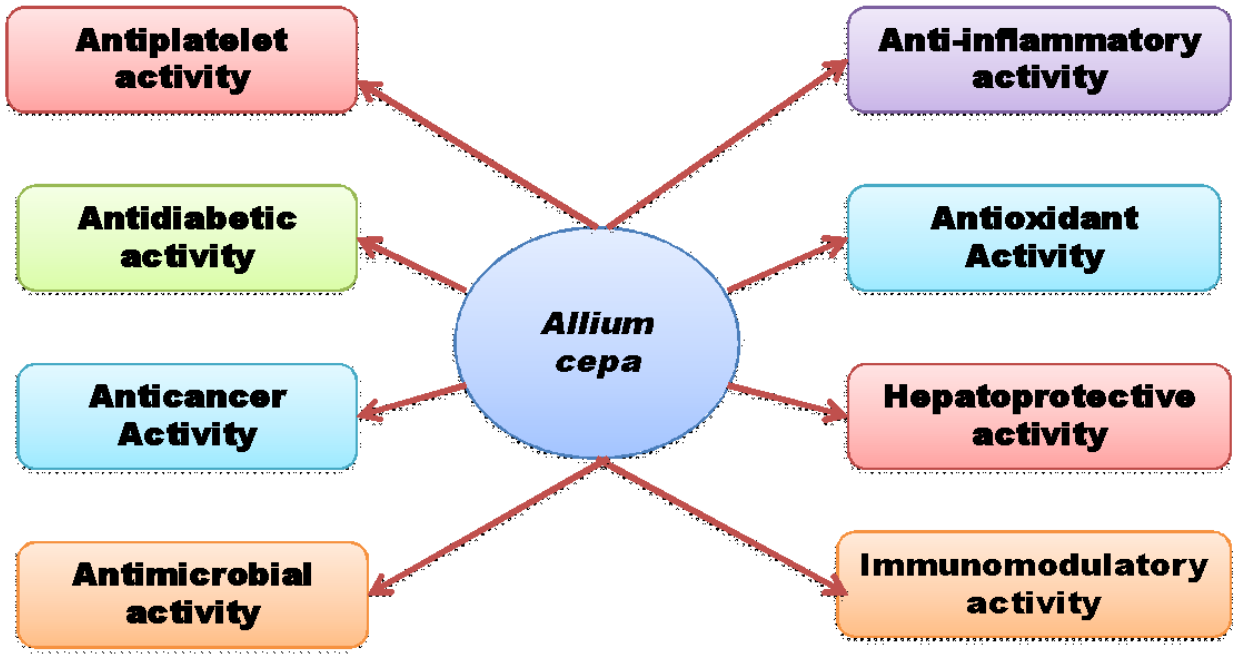

Figure 2: Schematic representation of different pharmacological activities of *Allium cepa*

of 47.16 ± 14.71 after incubation for 3 days. As it contains entadamide A-β-D-glucopyranoside it induces inhibition of MCF-7 cells. These findings predict the leek's potential being a regulator of food sources that can help increase antineoplastic activity.[35]

5.4. Antimicrobial activity

Red and white varieties of *Allium cepa* have shown strong antimicrobial and antioxidant activities. Fresh cold water extract of onion has shown antibacterial activity against four isolates include *Staphylococcus aureus*, *E.coli, Streptococcus pneumoniae* and Streptococcus pyrogenes and has antimicrobial activity against Vibrio cholerae *Pseudomonas aeruginosa, S. pneumoniae, E. coli, Staph. Aureus,* and *Staph. Aureus Salmonella typhi* and *E. coli.*[89] The biochemical analysis revealed that the three onion varieties are rich in therapeutic compounds. Onion extract possesses antimicrobial activity which revealed that they were effective against three Gram-positive bacteria (*S.aureus, B.cereus* and *L. innocua*), as well as P. aeruginosa; as a result, they may be a novel source of biological antimicrobial agents.[90]

5.5. Antioxidant Activity

Onions are high in quercetin, a strong antioxidant. Quercetin has been shown in a variety of studies to be a free radical scavenger and an inhibitor of LDL (low-density lipoprotein) oxidation. The red and white varieties of *Allium cepa* demonstrated antioxidant activity.[91] *Allium cepa's* quercetin-3'-O-beta-D glycoside exhibits antioxidant properties.[22] In aged rats, peel and flesh of *allium cepa* improve antioxidant level.[92] In alloxan diabetic rats, SMCS obtained from onion had anti-diabetic and antioxidant effects when compared to standard drugs.[93] Flavonols in the diet defend diabetic human lymphocytes from oxidative DNA damage.[94]

5.6. Hepatoprotective activity

Onion extracts were found to protect rats' livers from cadmium-induced oxidative damage[95]. Onion extract is preferred for dose-dependent hepatoprotection, as well

as preventing and protecting against cadmium-induced hepatotoxicity. Hepatoprotective action of an aqueous extract of *Allium cepa* bulb was found against ethanol-induced hepatotoxicity.[96]

5.7. Anti-inflammatory activity

Due to the flavonoid quercetin, onions have anti-inflammatory properties. Onions have anti-asthmatic properties[53] and are used to treat arthritis.[97] Ajoene is an anti-inflammatory natural product isolated from the Allium genus is known to possess anti-inflammatory activity.[98] The mechanism for the attenuation of atherosclerosis by fistula onion stalk extract involves the modulation of the local inflammatory response.[99]

5.8. Immunomodulatory effects

Various studies have also shown *A. cepa* constituents in cultured spleen cells stimulated with pokeweed (PWM) from Blomia tropicalis-sensitized BALB/c mice, quercetin (3.5, 7.5, 15 lg/mL) impeded the development of Th2 cytokines such as interleukin-4 (IL-4), IL-5, IL-13, and IgE.[100] The reviewed in vitro and in vivo studies reported that *A. cepa* and its constituents have modulatory effects on the immune system in a variety of immune dysregulatory disorders. The plant and its components, especially quercetin, decreased Th2 cytokines such as IL-4, IL-5, and IL-13, as well as IL-6, IL-8, IL-10, IL-1b, and TNF-a and IgE levels, while increasing CD4 cells, IFN-c levels, and the IFN-c/IL4 ratio (Th1/Th2 balance) in inflammatory disorders like asthma and breast cancer. However, in inflammatory conditions including LPS-induced osteoclastogenesis in RAW264.7 cells, *A. cepa* and quercetin decreased IL-6 and IL-1a development while increasing IL-3 and IL-4 levels.[101]

6. Conclusion

Allium cepa is being used since ancient times and is still used today. *Allium cepa* have numerous beneficial properties but more needs to be done to bring into foreplay its other properties too. The presence of phytochemicals helps to cure diverse ailments marks out *Allium cepa* of great value to the food and pharmaceutical industry. Considering its usefulness more stress should be put in to make Nanoparticles and other dosage forms because of its n number of medicinal properties.

7. Source of Funding

None.

8. Conflict of Interest

None.

References

1. Ramirez DA, Locatelli DA, González RE, Cavagnaro PF, Camargo AB. Analytical methods for bioactive sulfur compounds in Allium: an integrated review and future directions. *J Food Compos Anal*. 2017;61:4–19. doi:10.1016/j.jfca.2016.09.012.
2. Food and Agriculture Organization. Onion production worldwide; 2018. [last accessed 07 August 2018]. Available from: http://www.fao.org/faostat/en/#data/QC.
3. Corzo-Martínez M, Corzo N, Villamiel M. Biological properties of onions and garlic. *Trends Food Sci Technol*. 2007;18(12):609–25.
4. Brewster J. Onions and Other Vegetable Alliums. Wallingford, UK: CABI; 2008.
5. Keusgen M. Health and Alliums. In Allium Crop Science: Recent Advances. Rabinowitsch H, Currah L, editors. New York: CAB International; 2002. p. 357–78.
6. Hossain MM, Ahmed M, Haq ME, Shefat-Al-Maruf M, e Nabi MN, Majumder S, et al. Quality seed of onion: effect of micro and macronutrients. *Ann Res Rev Biol*. 2017;20(6):1–11. doi:10.9734/ARRB/2017/38172.
7. Khan SA, Jameel M, Kanwal S, Shahid S. Medicinal Importance of Allium Species: A Current Review. *Int J Pharm Sci Res*. 2017;2(3):29–39.
8. Marrelli M, Amodeo V, Statti G, Conforti F. Biological properties and bioactive components of Allium cepaL.: focus on potential benefits in the treatment of obesity and related comorbidities. *Molecules*. 2019;24(1):119. doi:10.3390/molecules24010119.
9. Yang W, Kim J, Lee JY, Kim C, Hwang C. Antihyperlipidemic and Antioxidative Potentials of Onion (Allium cepa L.) Extract Fermented with a Novel Lactobacillus casei HD-010. *Evid Based Complement Alternat Med*. 2019;p. 3269047. doi:10.1155/2019/3269047.
10. Food and Agriculture Organization of the United Nations. Rome, Italy; 2018. p. 57. Available from: https://www.fao.org/3/I9553EN/i9553en.pdf.
11. Onion (dried) production in 2017: crops world regions production quantity from pick lists. Food and Agriculture Organization, Statistics Division (FAOSTAT; 2017. [Accessed 18 July 2019]. Available from: https://www.fao.org/faostat/en/#data/QC. Accessed18.
12. FAO Statistical Database; 2013. Available from: http://faostat.fao.org.
13. Food and Agriculture Organization Statistical Pocketbook on world food and agriculture; 2015. Available from: https://www.fao.org/3/i4691e/i4691e.pdf.
14. Kik C. Allium genetic resources with particular reference to onion. *Int Soc Horticultural Sci*. 2008;770:135–8. doi:10.17660/ActaHortic.2008.770.14.
15. Darbyshire B, Steer BT. Carbohydrate biochemistry. In: Brewster J, Rabinowitsch H, editors. Onions and allied crops. vol. 3. Boca Raton: CRC Press; 1990. p. 1–16.
16. Block E. The Organosulfur Chemistry of the Genus Allium – Implications for the Organic Chemistry of Sulfur. *Angew Chem Int Ed Engl*. 1992;31(9):1135–78.
17. Fritsch RM, Keusgen M. Occurrence and taxonomic significance of cysteine sulphoxides in the genus Allium L. (Alliaceae). *Phytochemistry*. 2006;67(11):1127–35.
18. History of Onion; US National Onion Association. Greeley, CO, USA; 2017.
19. Jones MG, Hughes J, Tregova A, Milne J, Tomsett AB, Collin HA, et al. Biosynthesis of the flavour precursors of onion and garlic. *J Exp Bot*. 1903;55(404):1909–18.
20. Slimestad R, Fossen T, Vagen IM. Onions: a source of unique dietary flavonoids. *J Agric Food Chem*. 2007;55(25):10067–80.
21. Vagen IM, Slimestad R. Amount of characteristic compounds in 15 cultivars of onion (Allium cepa L.) in controlled field trials. *J Sci Food Agric*. 2008;88(3):404–11.
22. Yang J, Meyers KJ, Van Der Heide J, Liu RH. Varietal differences in phenolic content and antioxidant and antiproliferative activities of

onions. *J Agric Food Chem*. 2004;52(22):6787–93.
23. Lanzotti V. The analysis of onion and garlic. *J Chromatogr A*. 2006;1112(1-2):3–22.
24. Lim TK. Allium cepa. In Edible medicinal and non medicinal plants, Dordrecht; Stems, Roots, Bulbs. Springer; 2015. p. 124–203.
25. Li Q, Wang Y, Li H, Wang Z, Xu J, He X, et al. Health Benefits of the Flavonoids from Onion: Constituents and Their Pronounced Antioxidant and Anti-neuroinflammatory Capacities. *J Agric Food Chem*. 2020;68(3):799–807.
26. Vu NK, Kim CS, Ha MT, Ngo QM, Park SE, Kwon H, et al. Antioxidant and antidiabetic activities of flavonoid derivatives from the outer skins of Allium cepa L. *J Agric Food Chem*. 2020;68(33):799–807.
27. Reetha S, Bhuvaneswari G, Thamizhiniyan P, Mycin TR. Isolation of indole acetic acid (IAA) producing rhizobacteria of Pseudomonas fluorescensand Bacillus subtilis and enhance growth of onion (Allium cepa.L). *Int J Curr Microbiol App Sci*. 2014;3(2):568–74.
28. YassenAbouELNour A, AbouSeeda M, Abdallah M, El-Sayed S. Effect of potassium fertilization levels and algae extract on growth, bulb yield and quality of onion (AlliumcepaL.). *Middle East J Agric Res*. 2018;7(2):625–38.
29. Kaur G, Gupta V, Christopher AF. Kitchen phytochemicals from Allium cepa - their role in multidrug resistance. *Pak J Pharm Sci*. 2017;30(3):789–92.
30. Block E. The chemistry of garlic and onions. *Sci Am*. 1985;252(3):114–9.
31. Tedesco I, Carbone V, Spagnuolo C, Minasi P, Russo GL. Identification and quantification of flavonoids from two southern Italian cultivars of Allium cepa L., tropea (red onion) and montoro (copper onion), and their capacity to protect human erythrocytes from oxidative stress. *J Agric Food Chem*. 2015;63(21):5229–38.
32. Islam MS, Choi H, Du TL. Effects of dietary onion (Allium cepa L.) in a high-fat diet streptozotocin-induced diabetes rodent model. *Ann Nutr Metab*. 2008;53(1):6–12.
33. Banihani SA. Testosterone in Males as Enhanced by Onion (Allium Cepa L.). *Biomolecules*. 2019;9(2):75. doi:10.3390/biom9020075.
34. Godlewska K, Michalak I, Pacyga P, Baladyńska S, Chojnacka K. Potential applications of cyanobacteria: Spirulina platensis filtrates and homogenates in agriculture. *World J Microbiol Biotechnol*. 2019;35(6):80. doi:10.1007/s11274-019-2653-6.
35. Zamri N, Hamid HA, H. Comparative study of onion (Allium cepa) and leek (Allium ampeloprasum): identification of organosulphur compounds by UPLC-QTOF/MS and anticancer effect on MCF-7 cells. *Plant Foods Human Nutrition*. 2019;74(4):525–30.
36. Türkoğlu Ş. Determination of genotoxic effects of chlorfenvinphos and fenbuconazole in Allium cepa root cells by mitotic activity, chromosome aberration, DNA content, and comet assay. *Pestic Biochem Phys*. 2012;103(3):224–30.
37. Karaismailoglu MC. Investigation of the potential toxic effects of prometryne herbicide on Allium cepa root tip cells with mitotic activity, chromosome aberration, micronucleus frequency, nuclear DNA amount and comet assay. *Caryologia*. 2015;68(4):323–9.
38. Liman R, Ciğerci İH, Öztürk NS. Determination of genotoxic effects of imazethapyr herbicide in Allium cepa root cells by mitotic activity, chromosome aberration, and comet assay. *Pestic Biochem Physiol*. 2015;118:38–42. doi:10.1016/j.pestbp.2014.11.007.
39. Silveira GL, Lima MGF, Reis GD, Palmieri MJ, Andrade-Vieria LF. Toxic effects of environmental pollutants: comparative investigation using Allium cepa L. and Lactuca sativa L. *Chemosphere*. 2017;178:359–67.
40. Özkan S, Liman R. Cytotoxicity and genotoxicity in Allium cepa L. root meristem cells exposed to the herbicide penoxsulam. *Celal Bayar Üniversitesi Fen Bilimleri Dergisi*. 2019;15(2):221–6.
41. Çavuşoğlu K, Yalçin E, Türkmen Z, Yapar K, Sağir S. Physiological, anatomical, biochemical, and cytogenetic effects of thiamethoxam treatment on Allium cepa (amaryllidaceae) L. *Environ Toxicol*. 2012;27(11):635–43.
42. Sheikh N, Patowary H, Laskar RA. Screening of cytotoxic and genotoxic potency of two pesticides (malathion and cypermethrin) on Allium cepa L. *Mol Cell Toxicol*. 2020;16:291–9.
43. Tütüncü E, Yalçin E, Acar A, Yapar K, Çavuşoğlu K. Investigation of the toxic effects of a carbamate insecticide methiocarb in Allium cepa L. *Cytologia*. 2019;84(2):113–7.
44. Feretti D, Zerbini I, Zani C, Ceretti E, Moretti M, Monarca S, et al. Allium cepa chromosome aberration and micronucleus tests applied to study genotoxicity of extracts from pesticide-treated vegetables and grapes. *Food Addit Contam*. 2007;24(6):561–72.
45. Akgündüz M, Çavuşoğlu K, Yalçın E. The potential risk assessment of phenoxyethanol with a versatile model system. *Sci Rep*. 2020;10(1):1209. doi:10.1038/s41598-020-58170-9.
46. Brewster JL. Onions and Other Vegetable Alliums. Wallingford, UK: CABI; 1994.
47. Watson RR, Preedy VR, Patel VB. Nuts and seeds in health and disease prevention. 2011;p. 981–90.
48. Friesen NF, Reinhard M, Blattner FR. Phylogeny and New Intrageneric Classification of Allium (Alliaceae) Based on Nuclear Ribosomal DNA ITS Sequences. *Aliso*. 2006;22(1):372–95.
49. Lee Y, Hwang IG, Woo KS, Kim DJ, Hong JT, Jeong HS. Antioxidative activities of the ethyl acetate fraction from heated onion (Allium cepa). *Food Sci Biotechnol*. 2007;16:1041–5.
50. Sparnins VL, Barany G, Wattenberg LW. Effects of organosulfur compounds from garlic and onions on benzo[a]pyrene-induced neoplasia and glutathione S-transferase activity in the mouse. *Carcinogenesis*. 1988;9(1):131–4.
51. Osmont KS, Arnt CR, Goldman IL. Temporal aspects of onion-induced antiplatelet activity. *Plant Foods Hum Nutr*. 2003;58(1):27–40.
52. Kelkar SM, Kaklij GS, Bapat VA. Determination of antidiabetic activity in Allium cepa(onion) tissue cultures. *Indian J Biochem Biophys*. 2001;38(8):277–9.
53. Dorsch W, Schneider E, Bayer T, Breu W, Wagner H. Anti-inflammatory effects of onions: inhibition of chemotaxis of human polymorphonuclear leukocytes by thiosulfinates and cepaenes. *Int Arch Allergy Appl Immunol*. 1990;92(1):39–42.
54. Draelos ZD. The ability of onion extract gel to improve the cosmetic appearance of postsurgical scars. *J Cosmet Dermatol*. 2008;7(2):101–4.
55. Goudra PG, Ramachandra CT, Udaykumar N, Sharanagouda H. Studies on drying characteristics of onion (variety-Arka kalyan) slices using different drying methods. *J Pharmacogn Phytochemistry*. 2018;7(2):1013–6.
56. Hussein JB, Soji MY, Abiona OO, Oke MO. Drying characteristics of osmotically pretreated red onion slices via hot air oven. *J Food Processing Technol*. 2018;9(5):1–8. doi:10.4172/2157-7110.1000733.
57. Albishi T, Johna JA, Al-Khalifa AS, Shahidi F. Antioxidative phenolic constituents of skins of onion varieties and their activities. *J Funct Foods*. 2013;5(3):1191–203.
58. Mitra J, Shrivastava SL, Rao PS. Onion dehydration:A review. *J Food Sci Technol*. 2012;49(3):267–77.
59. Beretta VH, Bannoud F, Insani M, Galmarini CR, Cavagnaro PF. Variability in spectrophotometric pyruvate analyses for predicting onion pungency and nutraceutical value. *Food Chem*. 2017;224:201–6. doi:10.1016/j.foodchem.2016.12.031.
60. Kirtikar KR, Basu BD. Indian Medicinal Plants. Allahabad: Lalit Mohan Basu; 1935.
61. Shri R, Bora KS. Neuroprotective effect of methanolic extracts of Allium cepa on ischemia and reperfusion-induced cerebral injury. *Fitoterapia*. 2008;79(2):86–96.
62. DGP, Dudzik D, Colina-Coca C, de Ancos B, García A, Barbas C, et al. Evaluation of onion as a functional ingredient in the prevention of metabolic impairments associated to diet-induced hypercholesterolaemia using a multiplatform approach based on LC-MS, CE-MS and GC-MS. *J Funct Foods*. 2015;19:363–75. doi:10.1016/j.jff.2015.09.033.
63. Lee B, Seo JD, Rhee JK, Kim CY. Heated apple juice supplemented with onion has greatly improved nutritional quality and browning index. *Food Chem*. 2016;201:315–9.

doi:10.1016/j.foodchem.2016.01.092.
64. Arshad MS, Sohaib M, Nadeem M, Saeed F, Imran A, Javed A, et al. Status and trends of nutraceuticals from onion and onion by-products: A critical review. *Cogent Food* . 2017;3(1):1280254. doi:10.1080/23311932.2017.1280254.
65. Shon MY, Choi SD, Kahng GG, Nam SH, Sung NJ. Antimutagenic, antioxidant and free radical scavenging activity of ethyl acetate extracts from white, yellow and red onions. *Food Chem Toxicol*. 2004;42(4):659–66.
66. Price KR, Rhodes M. Analysis of the Major Flavonol Glycosides Present in Four Varieties of Onion (Allium cepa) and Changes in Composition Resulting from Autolysis. *J Sci Food Agric*. 1997;74:331–9. doi:10.1002/(SICI)1097-0010(199707)74:3<331::AID-JSFA806>3.0.CO2-C.
67. Nakano K, Takatani M, Tomimatsu T, Nohara T. Four kaempferol glycosides from leaves of Cinnamomum sieboldii. *Phytochemistry*. 1983;22(12):2831–3.
68. Park JC, Young HS, Yu YB, Lee JH. Isorhamnetin sulphate from the leaves and stems of Oenanthe javanica in Korea. *Planta Med*. 1995;61(4):377–8.
69. Furusawa M, Tanaka T, Nakaya KI, Iinuma M, Tuchiya H. A new flavonol glucoside from onion. *Heterocycles*. 2002;57(11):2175–7.
70. Ly TN, Hazama C, Shimoyamada M, Ando H, Kato K, Yamauchi R, et al. Antioxidative compounds from the outer scales of onion. *J Agric Food Chem*. 2005;53(21):8183–9.
71. Onions for your health." National Onion Association'; 2008. Available from: https://www.onions-usa.org/.
72. Block E. Reactions of Organosulfur Compounds. vol. 37. New York: Academic Press; 1978. p. 7.
73. Wang Y, Tian WX, Ma X. Inhibitory effects of onion (Allium cepa L.) extract on proliferation of cancer cells and adipocytes via inhibiting fatty acid synthase. *Asian Pac J Cancer Prev*. 2012;13(11):5573–9.
74. Kadan S, Saad B, Sasson Y, Zaid H. In vitro evaluations of cytotoxicity of eight antidiabetic medicinal plants and their effect on GLUT4 translocation. *Evid Based Complement Alternat Med*. 2013;p. 549345. doi:10.1155/2013/549345.
75. Ebrahimi-Mamaghani M, Saghafi-Asl M, Pirouzpanah S, Asghari-Jafarabadi M, M. Effects of raw red onion consumption on metabolic features in overweight or obese women with polycystic ovary syndrome: A randomized controlled clinical trial. *J Obstet Gynaecol Res*. 2014;40(6):1067–76.
76. "Onions." World's Healthiest Foods ; 2008.
77. Augusti KI, Roy VC, Semple M. Effect of allyl propyl disulphide isolated from onion (Allium cepa L.) on glucose tolerance of alloxan diabetic rabbits. *Experientia*. 1974;30(10):1119–20.
78. Sheela CG, Kumud K, Augusti K. Antidiabetic effects of onion and garlic sulfoxide amino acids in rats. *Planta Med*. 1995;61(4):356–7.
79. Sabiu S, Madende M, Ajao AA, Aladodo RA, Nurain IO, Ahmad JB, et al. The Genus Allium (Amaryllidaceae: Alloideae): Features, Phytoconstituents, and Mechanisms of Antidiabetic Potential of Allium cepa and Allium sativum. In: Bioactive Food as Dietary Interventions for Diabetes (Second Edition). 10.1016/B978-0-12-813822-9.00009-6: Acadmic Press; 2019. p. 137–54.
80. Oloyede A, Okpuzor J, Omidiji O. Cytological and toxicological properties of a decoction used for managing tumors in Southwestern Nigeria. *Pak J Biol Sci*. 2009;12(4):383–7.
81. Byun S, Park J, Lee E, Lim S, Yu JG, Lee SJ, et al. Src kinase is a direct target of apigenin against UVB-induced skin inflammation. *Carcinogenesis*. 2013;34(2):397–405.
82. Herman-Antosiewicz A, Singh SV. Signal transduction path ways leading to cell cycle arrest and apoptosis induction in cancer cells by Allium vegetable-derived organosulfur compounds: A review. *Mutat Res*. 2004;555(1-2):121–31.
83. González-Peña D, Colina-Coca C, Char CD, Cano MP, De Ancos B, Sanchez-Moreno C, et al. Hyaluronidase inhibiting activity and radical scavenging potential of flavonols in processed onion. *J Agric Food Chem*. 2013;61(20):4862–72.
84. Yu CS, Lai KC, Yang JS, Chiang JH, Lu CC, Wu CL, et al. Quercetin inhibited murine leukemia WEHI-3 cells in vivo and promoted immune response. *Phytother Res*. 2010;24(2):163–8.
85. Galluzzo P, Martini C, Bulzomi P, Leone S, Bolli A, Pallottini V. Quercetin-induced apoptotic cascade in cancer cells: Antioxidant versus estrogen receptor alpha-dependent mechanisms. *Mol Nutr Food Res*. 2009;53(6):699–708.
86. Prasanna VK, Venkatesh YP. Characterization of onion lectin (Allium cepa agglutinin) as an immunomodulatory protein inducing Th1-type immune response in vitro. *Int Immunopharmacol*. 2015;26(2):304–13.
87. Niukian K, Schwartz J, Shklar G. In vitro inhibitory effect of onion extract on hamster buccal pouch carcinogenesis. *Nutr Cancer*. 1987;10(3):137–44.
88. Hung H. Dietary quercetin inhibits proliferation of lung carcinoma cells. *Forum Nutr*. 2007;60(2):146–57.
89. Jose S, Krishnakumar KAR, On, Pharmacological, Allium O. A review on phytochemical and pharmacological studies on allium CEPA. *Asian J Pharm Anal Med Chem*. 2017;5(1):32–6.
90. Liguori L, Adiletta G, Nazzaro F, Fratianni F, Matteo MD, Albanese D, et al. Biochemical, antioxidant properties and antimicrobial activity of different onion varieties in the Mediterranean area. *J Food Meas Characterization*. 2019;13(6):1232–41.
91. Benmalek Y, Yahia OA, Belkebir A, Fardeau ML. Anti-microbial and anti-oxidant activities of Illicium verum, Crataegus oxyacantha ssp monogyna and Allium cepa red and white varieties. *Bioengineered*. 2013;4(4):244–8.
92. Renzo LD, Pierro DD, Bigioni M, Sodi V, Galvano F, Cianci R. Is antioxidant plasma status in humans a consequence of the antioxidant food content influence? *Eur Rev Med Pharmacol Sci*. 2007;11(3):185–92.
93. Kumari K, Augusti KT. Antidiabetic and antioxidant effects of S-methyl cysteine sulfoxide isolated from onions (Allium cepa Linn) as compared to standard drugs in alloxan diabetic rats. *Indian J Exp Biol*. 2002;40(9):1005–9.
94. Lean ME, Noroozi M, Kelly I, Burns J, Talwar D, Sattar N, et al. Dietary flavonols protect diabetic human lymphocytes against oxidative damage to DNA. *Diabetes*. 1999;48(1):176–81.
95. Obioha UE, Suru SM, Ola-Mudathir KF, Faremi TY. Hepatoprotective potentials of onion and garlic extracts on cadmium-induced oxidative damage in rats. *Biol Trace Elem Res*. 2009;129(1-3):143–56.
96. Kumar KE, Harsha KN, Sudheer V, Nelli GB. In vitro antioxidant activity and in vivo hepatoprotective activity of aqueous extract of Allium cepa bulb in ethanol induced liver damage in Wistar rats. *Food Sci Hum Wellness*. 2013;2(3-4):132–8.
97. Wagner H, Dorsch W, Bayer T, Breu W, Willer F. Antiasthmatic effects of onions: inhibition of 5-lipoxygenase and cyclooxygenase in vitro by thiosulfinates and "Cepaenes". *Prostaglandins Leukot Essent Fatty Acids*. 1990;39(1):59–62.
98. Dirsch VM, Vollmar A. Ajoene, a natural product with non-steroidal anti-inflammatory drug (NSAID)-like properties? *Biochem Pharmacol*. 2001;61(5):587–93.
99. He B, Hao J, Sheng W, Xiang Y, Zhang J, Zhu H, et al. Fistular onion stalk extract exhibits anti-atherosclerotic effects in rats. *Exp Ther Med*. 2014;8(3):785–92.
100. Campos K, Diniz Y, Cataneo A, Faine L, Alves M, Novelli E, et al. Hypoglycaemic and antioxidant effects of onion, Allium cepa: dietary onion addition, antioxidant activity and hypoglycaemic effects on diabetic rats. *Int J Food Sci Nutr*. 2003;54(3):241–6.
101. Ghorani V, Shakeri F, Boskabady M, Kianian F. Hypoglycaemic and antioxidant effects of onion, Allium cepa: dietary onion addition, antioxidant activity and hypoglycaemic effects on diabetic rats. *Int J Food Sci Nutr*. 2020;54(3):241–6.

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