



ONION'S (ALLIUM CEPA L.) PHARMACOLOGICAL PROPERTIES AND ETHNOPHARMACOLOGICAL TENDENCY

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ABSTRACT

One of the most popular and widely cultivated vegetable crops worldwide is onions (*Allium cepa* L.). Onion bulbs are highly valued commercially and rank third in significance among horticulture spices due to their distinct flavor. Many indigenous societies have long utilized *A. cepa* for its therapeutic qualities in addition to its culinary applications. To support these popular views, a number of publications have been created. However, current, thorough information about the traditional and ethnopharmacological properties of *A. cepa* is scarce. Therefore, this study aims to conduct a thorough analysis of the published literature regarding the phytochemical composition, pharmacological characteristics, and traditional use of *A. cepa*. Numerous pharmacological qualities, including antibacterial, antioxidant, analgesic, anti-inflammatory, anti-diabetic, hypolipidemic, anti-hypertensive, and immunoprotective qualities, have been discovered in *A. cepa*. Despite the large number of in vitro and in vivo studies that have been carried out, several limitations and information gaps remain that require further research.

Key Words: *Allium cepa* L., Onion, Ethnopharmacological tendency, Pharmacological Characteristics.

INTRODUCTION

Nowadays, a wide range of sectors across the globe support the circular economy (CE) framework [1]. The linear economy is based on the "take, make, and dispose" principle [2]; the circular economy (CE) seeks to use resources more efficiently by minimising waste and preserving long-term value [3]. Therefore, the CE is a feasible solution that promotes resource efficiency to maximise financial rewards and reduce environmental impact [4]. The European Commission estimates that the industrial industry alone might benefit 600 billion euros a year from the CE transition [1]. A large amount of the organic waste produced by the agro-industry is either disposed of in landfills or used to create goods with minimal added value.

However, the goal of the CE idea is to transform this waste into products like cosmetics, nutraceuticals, and pharmaceuticals that have a large market value [5,6]. Secondary food products often contain valuable chemicals that can be used as functional additions in the food, cosmetics, and pharmaceutical industries [7]. With a harvest estimated to be over 89 million tonnes, onions (*Allium cepa* L.) are the second most extensively produced crop in the world after tomatoes [5,6]. The onion's immense appeal can be attributed to its variety. It can be eaten fresh or prepared in a number of ways, including as boiling, baking, grilling, frying, and so on [8].

The use of onions as a flavouring or spicy ingredient, as well as a source of bioactive phytonutrients, has led to a recent increase in global onion production of at least 25% [7,9]. Regular consumption of onions has been shown in numerous epidemiological studies to reduce the risk of various cancers, cardiovascular and

neurological illnesses, and other diseases linked to oxidative stress. It is well recognised that onions are a good source of antioxidant molecules and can help prevent a number of oxidative stress-related disorders [8,10]. More than 550,000 tonnes of bio-waste are produced during the peeling, chopping, and dicing of onions [5,6].

There's also a lot of rubbish produced by these operations [11]. The last two years have seen an explosion in pertinent scientific studies, which suggests that interest in onion garbage has grown significantly in recent years. This is a result of the cheap and easy accessibility of this trash. But in onion processing, onion skin makes up the majority of trash (up to 60%) [7,11], with the remaining waste biomass consisting of damaged bulbs, tops of the bulbs, and roots [6,12]. Onion waste is usually disposed of in landfills, which is undesirable for the environment because it has an unpleasant taste and smell and cannot be utilised as organic fertiliser or as animal feed [5-7]. On the other hand, onion peel has a high concentration of antioxidant polyphenols, especially quercetin and its derivatives, a class of flavonoids called glucosides, kaempferol, gallic acid, ferulic acid, and all of them have a lot of good effects on biological processes like antidiabetic, antioxidant, anti-inflammatory, antitumor, and enzyme-inhibitory effects [5,13]. In terms of onion varieties, the most prevalent flavonols in all varieties—white, yellow, or red—are quercetin and its derivatives as well as glucosides. In contrast, red onions are the main source of anthocyanins, which make up around 10% of the total flavonoid content in fresh weight [7,9]. Pearls have the highest amounts of noteworthy flavonoids, such as quercetin and its glucosides, followed by the husks of red, yellow, and white onions [11,13]. The conditions under which the flavonoids were extracted also have a major effect [14].

Onions make up a significant portion of all vegetables grown in Russia. Eaten in three colours (yellow, white, and red), yellow onions are the most popular. The purpose of this study was to assess the antioxidant capacity of these three types of husk waste.



Figure.1; Onion (*Allium cepa* L)

CHEMICAL CHARACTERISTICS OF ALLIUM CEPA

Onions are high in sugar, primarily water, and dietary fibre. The onion is rich in folic acid, vitamin B6, magnesium, calcium, potassium, and phosphorus and low in sodium in terms of vitamins and minerals. The two notable amino acids in onions, which have a minimal lipid content, are just glutamic acid and arginine [1]. Several compounds responsible for *A. cepa*'s unique scent and medicinal properties have been found through a multitude of phytochemical investigations. Phenolic compounds have attracted the attention of several phytochemical classes due to their ability to assist the biological processes of medicinal plants.

A research on four *A. cepa* variants (violet, red, green, and white) for their compliance with the high-performance liquid chromatography (HPLC) was performed [14]. Kaempferol, ferulic acid, quercetin, gallic acid, and protocatechuic acid were also identified. The number of phenolic compounds found in each variety varied significantly, e.g., gallic acid (9.3–354 lg/g), ferulic acid (13.5–116 lg/g), quercetin (14.5–5110 lg/g),

protocatechuic acid (3.1–138 lg/g), and kaempferol (3.2–481 lg/g). In addition, a variety of flavonoids were discovered in various onion varieties: quercetin-4-O-monoglucoside [15], isorhamnetin 3,4-O-diglucoside, quercetin-3,4-O-diglucoside, quercetin aglycon, quercetin-3-O-monoglucoside, delphinidin 3,5-O-diglycosides, quercetin 3-O-glycosides [16], quercetin 7,4-O-diglucoside, quercetin 3,7,4-O-triglucoside, quercetin 3,4-O-diglucoside [17], and many others. When compared to apples (50 mg/kg), broccoli (100 mg/kg), and blueberries (40 mg/kg), *A. cepa* has 5 to 10 times higher quercetin content (300 mg/kg) [18]. Moreover, various experiments have found various onion anthocyanins: cyanidin 7-O-(3-O-malonyl- β -glucopyranosyl)-6-O-malonyl- β -glucopyranoside, cyanidin 3-O-(3-O-malonyl- β -glucopyranosyl)-6-O-malonyl- β -glucopyranoside, cyanidin 4-O- β -glucoside, cyanidin 3,4-O-di- β -glucopyranoside, peonidin 3-O-(6-O-malonyl- β -glucopyranoside), and peonidin 3-O-(6-O-malonyl- β -glucopyranoside)-5-O- β -glucopyranoside were present in minute amounts from parts which are pigmented of red onion [17]. Additionally, four anthocyanins with the same unique structure were produced by methanolic extracts of red onions. Two of their structures were identified as 4-substituted aglycone, carboxypyranocyanidin, 5-carboxypyranocyanidin 3-O-glucopyranoside, and 5-carboxypyranocyanidin 3-O-(6''-O-malonyl-glucopyranoside) [19]. Additionally, Malvidin 3'-glucoside and Peonidin 3'-Glucoside Acetate were effectively established by Fredotovic et al. [20]. According to a study by VazquezArmenta et al., the two primary components of onion oil are dipropyl trisulfide and dipropyl disulfide [21]. A class of biologically active organo-sulfuric chemicals is known as S-alk(en)yl-L-cysteine sulfoxides, and includes substances like *c*-glutamylcysteine and alliin. Fresh onion flavour and scent are produced as methiine, allicin, iso-alliin, propin, and lipid-soluble sulphur compounds are released during the crushing of plant components (for example, diallyl-disulfide and diallyl sulfide). The irritating lachrymatory component that is released when an onion is chopped is thought to form spontaneously as a result of the action of the enzyme alliinase [22]. Another thiopropal S-oxide chemical, the sulphide volatile, is a lachrymatory component found only in onions that eventually converts thiopropal S-oxide to methylpentanols [23]. Thin-layer chromatography with dichloromethane extraction also revealed many disulfide radicals (methyl, allyl, and propyl) in the red onion varieties [24]. Quantitative analyses have revealed that the abundance of tri- and disulfides, such as trans- and cis-methyl-1-propenyl disulfides, dipropyl disulfides, methyl-2-propenyl disulfides, trans- and cis-propenyl propyl disulfides, and methyl propyl trisulfides, is over 60%. The bulb extracts also included certain organic acids, according to Dhumal et al. They were succinic, ascorbic, tartaric, malic, oxalic, and citric acids. Moreover, Liguori et al. (Italy) discovered many aldehydes and ketones in the onion land races of Bianca di Pompei cv., grown in the region Campania [25]. The most prevalent and potent test of all was furfuraldehyde in Aprilatica. Propionaldehyde and 2-methyl-2-pentenal material samples varied between landraces. Pentanedione's 1,2-cyclo concentration was higher than that produced during the months when Maggiaiola, Aprilatica, and Giugnese onions were not harvested throughout the winter (Marzatica and Febbrare). The butyrolactone recipe only used spring-harvested onions (Maggiaiola, Aprilatica, and Giugnese). Aqueous extraction on DEAE cellulose, ion exchange chromatography, affinity chromatography on FPLC-gel filtration, and affi-gel blue gel on Superdex were used to isolate the antifungal peptide allicepin. Another chemical discovered from bulbs called Zwiebelane A (cis-2, 3-dimethyl-5, 6-dithiabicyclohexane 5-oxide) was found to increase the potential fungicidal activity of the conventional antibiotic polymyxin B [27]. The flavouring created during frying is called zwiibelane A. From the bulbs, Tverskoy et al. discovered two more phytoalexins. They are 5-octyl- and 5-hexyl-cyclopenta-1,3-dione [2] respectively.

BIOACTIVE SUBSTANCES

The abundance of sulphur compounds in onions, which cause the throat and back of the mouth to burn, are what give them their pungent flavour. An efficient method for determining onion pungency is to analyse the pyruvic acid that thiosulfins create in stoichiometric proportions. Pyruvic acid and flavour perception have been found to be correlated. The mix of pungency and sugar in an onion determines its sweetness. To

prevent the onion from being thought of as sweet, a strong pungentness will mask a high sugar content. Onions with little flavour and little sweetness may likewise be thought of being tasteless. A sweet onion should have high sugar content and low pungency [28]. Particularly in the presence of heat, isulfates are unstable and split into a variety of compounds, the most common of which are mono-, di-, tri-, and tetrasulfides. Dipropyl trisulfide, dipropyl disulfide, and propenyl disulfides are the major components of onion volatiles. Several additional substances, such as dipropenyl sulphide and dipropyl sulphide, have also been identified [31]. Yamazaki et al. have identified 11 sulfur-containing taste precursors in onions, including methiin, S-alkyl-L-cysteine derivatives, isoalliin, alliin, deoxyalliin, cycloalliin, and N-(gamma-glutamyl)-S-(2-propenyl) N-nitroso L-cysteine (gamma-glutamyl) The compound S-methyl-L-cysteine, N-(gamma-glutamyl)-S-(2-propenyl) N-nitro-L-cysteine sulfoxide (gammaglutamyl) -S-(E-1-propenyl) S-(2-carboxypropyl) glutathione, N-(gamma-glutamyl)-S, and L-cysteine (Glu-PEC) (E-1-propenyl) Glu-PECSO (L-cysteine sulfoxide) [32]. Numerous intriguing new chemicals have been isolated from onions, according to recent literature. With their potential health benefits, peptides and saponin have been extracted and studied. In *Allium* species, several saponins have been identified, and processing has led to the reoccurrence of numerous saponins [33,34]. In vitro inducers of glutathione S-transferase and quinone reductase were discovered, including 5-Hydroxy-3-methyl-4-propylsulfanyl-5H-furan-2-one and four additional substances [35]. The saponins extracted from onions and garlic have been shown in several studies to have anticancer, antifungal, blood coagulability, cytotoxicity, cholesterol-lowering, and antispasmodic properties [33]. Four furostanol saponins, including two new compounds termed ceposide A and ceposide B, were identified from the seeds of *A. cepa* [36]. Additionally, Corea et al. found novel saponins that showed antispasmodic activity in the isolated ileum of the guinea pig, an effect that would support the conventional use of ointment in the treatment of digestive disorders [34]. In vitro osteoclast development and activity have also been shown to be inhibited by gamma-glutamyl onion peptide [37,38]. As they directly contribute to the energy needed for drying, which is crucial in the onion dehydration sector, the contents of dry matter bulbs represent a significant onion quality criterion [39,40]. The dry bulb is composed of nonstructural carbohydrates to a degree of 65 to 80%. Although low molecular fructans are lacking, the three main nonstructural carbohydrates found in onions are glucose, fructose, and sucrose. Onions have a significant carbohydrate reserve known as FOS, which is a polyfructose with various molecular sizes. The name for fructans is fructooligosaccharides (FOS). When the bulbs are developing and sprouting, fructans build up during bulbing and catabolism [39]. Only fructose oligomers with fructosyl units (F) attached to sucrose position (GF + fructose) by β linkage and principally made of nystose (GF3), ketose (GF2), and fructofuranosyl nystose (GF4) are referred to be FOS in popular usage. Every onion tissue contains ketoses (GF2) in abundant amounts, but there are no substantially polymerized fructans. The fleshy layers are the most productive tissues, making the outer two fleshy layers the most abundant byproduct of the onion and a possible source of fructan [41,42]. Onion typically has a fructan degree of polymerization (DP) level between 3 and 15. Theoretically, short chain fructans with polymerization rates under five can be employed as natural sweeteners. For lipid substitution, onion bulbs with high DP fructans may be employed, with possible consequences. Compared to other vegetables, onions have a higher ratio of soluble to insoluble nutritional fibre (SDF: IDF), which has been associated to a variety of physiologic and metabolic consequences. IDF reduces intestinal transit and increases meal mass for the majority of people, but SDF increases stomach viscosity, leading nutrients to be decreased and absorbed [43]. The health benefits of *Allium* vegetables have been supported by numerous in vitro, in vivo, and ex vivo studies. Onions have been specifically recognised as having anticarcinogenic, antioxidant, hypoglycemic, hypolipidemic, and antiaggregatory properties. From a nutritional and medical perspective, it is clear that onions, which are frequently used as a vegetable or food element in recipes, are frequently extremely beneficial in their treatments. A diet high in vegetables, especially onions, has been

linked to a range of health benefits, including the prevention of CVD and cancer resurgences, two of today's most significant and common diseases [1].

THERAPEUTIC POTENTIAL OF ALLIUM CEPA

Allium cepa has been recognised as an efficient antibacterial agent for the treatment of infectious illnesses. Numerous A. cepa solvent extracts have been reported to be effective against numerous fungi, bacteria, and viruses [2]. In a study by Liguori et al. [25], the impact of compound organosulfur on the proliferation of microorganisms has been reevaluated. While it wasn't as effective as kaempferol in stopping the growth of *L. monocytogenes*, *B. cereus*, and *P. aeruginosa*, quercetin was just as effective at stopping the development of *M. luteus* and *S. aureus* [44]. Another study found that the essential oils of red, green, and yellow onions were highly effective at inhibiting the growth of a number of pathogens, including *Salmonella enteritidis*, *Fusarium oxysporum*, *Penicillium cyclopium*, *Staphylococcus aureus*, and *Aspergillus Niger* [39]. It has been demonstrated that the red A. cepa extract has more antibacterial capabilities than the yellow and white types [45]. One of the most popular and widely farmed vegetable crops worldwide is the onion (*Allium cepa* L.). The onion bulb, which has a distinctive flavour and is the third-most important horticultural spice, has a high commercial value. A. cepa is traditionally used for its therapeutic benefits in a wide range of indigenous cultures in addition to its culinary benefits. Numerous publications have been created in an effort to support these conventional views. However, there is still a severe lack of current, a thorough compiling and evaluation of A. cepa's traditional and ethnopharmacological tendencies. Therefore, the objective of the current review is to thoroughly examine the published literature on the traditional uses, pharmacological characteristics, and phytochemical makeup of A. cepa. Numerous pharmacological qualities, including as antibacterial, antioxidant, analgesic, anti-inflammatory, anti-diabetic, hypolipidemic, anti-hypertensive, and immunoprotective activities, were discovered in A. cepa. Although several in vitro and in vivo investigations have been carried out, there are still a number of restrictions and knowledge gaps that must be filled in future research.[46]

CONCLUSION

The purpose of the current study is to update and modify the compilation of A. cepa-related studies. Teshika et al; relatively little attention placed on the ethnopharmacological uses of this plant, this compilation sought to highlight the medicinal features of A. cepa crop. However, this approach might be seen as an effort to include slivers of scientific data based on the A. cepa's ethnopharmacology. Attempts were also made designed to deepen and broaden understanding of the herb that has been utilised traditionally for its unnecessary medicinal characteristics, bioactive makeup, and pharmacological aspects. A. cepa might be thought of as a source of essential phytopharmaceuticals with potential uses in developing disciplines of study.

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