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(RESEARCH ARTICLE)

Phytochemical analysis and a review on biological importance of *Allium cepa. L*

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Abstract

A biogenic substance may be a product created by or of life forms. The term encompasses constituents, secretions, and metabolites of plants or animals. In context of biological science, biogenic substances are cited as bio molecules. Onion *(Allium cepa L.*) has been valued as a food and a meditative plant since precedent days. It wide cultivated, second solely to tomato, and may be a vegetable bulb crop notable to most cultures and consumed worldwide. It's a brief period agriculture crop grownup at low latitudes. It's unremarkably called "Queen of the kitchen" due to its extremely valued flavor, aroma, and distinctive style. Recently, onion has drawn attention in many areas to its biological effects for human health. Besides well-known inhibitor activity due to the presence of radical scavenging property, consequently, there's increasing demand on the sensible technique to get such bioactive compounds from numerous plant supply. To utilize such valuable bioactive compounds within the plants, ways to isolate such substances from the source are required promptly. Therefore, identification of biologically active parts in onion plant by techniques like DPPH radical scavenging, total phenol content and total flavonoid tests are of great importance in medical and biological fields. Herein, we reported a review on biological importance of outer peel of onion and also identified biologically important components present in the sample.

Keywords: *Allium cepa* L; Biological importance; Phytochemical analysis; Total phenol; Total flavonoids; Free radical scavenging assay;

1. Introduction

1.1. Onion- Botany and Production statistics

Onions have been used by humans since the Neolithic age, and they are still being used all over the world. Over this long period, there have always been people who have appreciated the use of onions and used them in considerable quantities, but there have also been those who have rejected and detested them[1] .Onions are cultivated globally, in a minimum of one hundred seventy five countries, for around 5000 years[2]. Ancient Egyptians regarded the spherical bulb as a logo of the universe. The name is probably is taken from the Latin *unus* meaning "one" and the Romans introduced the onion to Britain, from where it may have been carried to the Americas[3]. The first known written report about the onion comes from the Sumerians and dates back to 2600–2100 BC. In the Papyrus Ebers, which is based on ancient Egyptian writings and knowledge we discover that Leek played an important role in the kingdom of old Egypt. The great medical practitioner medical an urged onion as a drug and laxative, He conjointly used onion for the treatment of respiratory disease and, externally, for healing putrid wounds[4]. Onion is a biennial bulb crop, with world production of 74,250,809 tons from a district of 4,364,000 hectares. China and India are the primary onion growing

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countries, followed by the USA, Egypt, Iran, Turkey, Pakistan, Brazil, the Russian Federation, and the Republic of Korea. Onion productivity is highest in the Republic of Korea (66.16 t/ha), followed by the USA (56.26 t/ha), Spain (53.31 t/ha), and the Netherlands (51.64 t/ha); the average productivity across the world is 19.79 t/ha. From an economic point of view, the international trade in onion exports is 6.77 million tonnes. The Netherlands is the highest onion exporter (1.33 million tons) followed by India, China, Egypt, Mexico, USA, Spain, and Argentina. Bangladesh, Malaysia, the Russian Federation, the UK, Japan, and Asian nation are the main onion importation countries within the world. The genus Allium is very large and consists of many wild edible species (only a small fraction is cultivated commercially), and is widely distributed over temperate zones in the northern hemisphere[5]. The place of origin is purported to be in central Asia, and the Mediterranean regions are considered to be the secondary center of origin. The genus Allium contains more than 780 species [6] with large diversities in morphological characters. The chromosome number of onion is 16(2n).

Onion belongs to the family Amaryllidaceae; the plant is either biannual or perennial (depending on the cultivar), and smells when crushed[7]. The plant has shallow adventitious fibrous roots, bulb, and tubular leaves. The stem grows 100–200 cm tall during the second year of the plant's life. The green leaves of the plant are an extension of the outer food storage leaves. The inflorescence is umbel-like and develops from a ring-like apical meristem[8]. The umbel is the aggregation of flowers at various stages of development, and it contains 200–600 small individual flowers, although this number can range from 50 to 1000 [9]. It is composed of white or greenish-white small flowers which grow at the tip of the stem in the second year of the plant. The onion bulb ranges in shape from flat to globular to oblong, and the onions are usually of three colors: red, white, and yellow [10]. The fruits are capsule and contain black seeds. The bulb is composed of fleshy and enlarged leaf bases. The edible onion bulb can grow up to 10 cm in diameter, and it is composed of several overlapping layers on a central core. The outer leaf bases of the bulb lose moisture and become scaly by the time of harvesting, and the inner leaves thicken as the bulb develops. The majority of the species of onion grow in open, sunny, and dry land, mainly in humid climates. However, the Allium species have been adopted in other ecological niches of the world [11].

Figure 1 *Allium cepa.L*

1.2. Biological Importance and major Phytochemicals

Onions not only provide flavor, but also provide health promoting phytochemicals. Phytochemicals are natural compounds found in onions which have the potential to promote health benefits in humans and offer protection from a variety of diseases, including cancer. The organo-sulfur compounds have antimicrobial, antiallergenic, anti-inflammatory, and antithrombotic activity [12]. As well as this, flavonols in onions, such as quercetin and kaempferol, also possess different crucial biological roles for health maintenance, like antiviral, antimicrobial, anti-inflammatory, and anticancer activity, along with protection of the brain[13].

Onions are a very common and rich source of dietary flavonoids, and contain three diverse and highly valuable phytochemicals in perfect proportion: flavonoids, fructans, and organosulfur compounds. These compounds are believed to provide beneficial effects for human health [14]. Onions are major contributors of flavonoids and organo-sulfur compounds, which are powerful antioxidants [15]. The whole bulb of onions are a good source of (+)-S-alk (en) yl-L-cysteine sulfoxide and of γ-glutamyl peptide, which together account for over 70% of the total 4dourle in onions16. There are three main non-volatile and 4dourless alk (en) yl cysteine sulfoxides present in onions. These are S-trans-prop-1-enyl cysteine sulfoxide (isoalliin), S-methyl cysteine sulfoxide (methiin), and S-propyl cysteine sulfoxide (propiin) 17. The predominant flavor precursor is isoalliin, which accounts for more than 80% of the total amount of

alknyl cysteine sulfoxides. Methiin appears in lower concentrations, while alliin and propiin are present in trace amounts18. This leads to the formation of new compounds, such as alkyl alkane-thiosulfinates, which have an influence on the characteristic odor and flavor of alliums19. These ingredients may be decomposed to other organosulfur compounds, including propyl-1-propanyl thiosulfinate, 1-propanethial-S-oxide, allicin, dipropyl disulfide, diallyl sulfide, methyl propanyl disulfide, and ajoene. Simultaneously, γ-glutamyl amino acid is additionally reborn to totally different organosulfur compounds, together with S-allyl amino acid and S-allyl mercaptocysteine20.

A wide range of organosulfur compounds is found in onions, mainly including four types of diallyl sulfides: diallylmonosulfide (DMS), diallyldisulfide (DDS), diallyltrisulfide (DTS), and diallyltetrasulfide (DTTS) [21]. Onions are considered an outstanding source of flavonoids, which are part of the polyphenols family. Flavonol is a subclass of flavonoids, which includes quercetin, a chief and prominent dietary flavonoid of onions. Along with quercetin, other flavonols, such as kaempferol and isorhamnetin, have also been measured in onions 22. Apart from these, onions contain various sulfoxides, such as (+)-S-(1-propenyl)-L-cysteine sulfoxide (PRENCSO), (+)-S-methyl-L-cysteine sulfoxide (MCSO), S-propyl-L-cysteine sulfoxide, S-methyl-L-cysteine sulfoxide, and S-propenyl-L-cysteine sulfoxide (Mateljan, 2015). The other phytochemicals found in onion extract are recognized as allicin (S-oxydiallyldisulfide), alliin (S-allyl-L-cysteine S-oxide), diallyldisulfide (allyldisulfide), S-methyl-L-cysteine S-oxide (3-methyl sulfinyl alanine), propanethial S-oxide (thiopropanal S-oxide), and 3-mercapto-2-methypentan-1-ol. Ascorbic acid is the most abundant vitamin found in the onion bulb, with a concentration of 1 mg/g dry weight23.

Onion contains hormone saponins that stop absorption of cholesterin within the bowel. Fructans (polysaccharides) are the principal storage carbohydrates in onions. In a study of 60 vegetables, onions were reported to have the highest quantity of fructans, which have the potential to decrease the population of bacteria [24]. The main content of fructans is fructooligo saccharides. Experiments for the separation and identification of fructooligosaccharides have been performed using advanced techniques, like HPAEC-PAD (high performance anion exchange chromatography with pulsed amperometric detection) and MALDI-MS (matrix-assisted laser desorption/ionization mass spectroscopy)which revealed that the vacuoles of the cells possess fructooligosaccharides. The fructooligosaccharides class is made up of several fructo furanosyl sucrose subunits that are collectively known as 1-kestose (3a), neokestose (3b), nystose (4a), and so [25]. Onion contains two types of flavonoids, i.e. flavonols and anthocyanins. The major flavonols are quercetin, kaempferol, and isorhamnetin. The secondary metabolites found in onions, phenolics, have antioxidant activity and are composed of hydroxylated aromatic rings [26].

Onion is one of the most common and richest natural sources of flavonoids. Among flavonoids within the onion, quercetin and its glycoside are well known major substances. Though several studies on this were progressed with whole onions, the retrieval of helpful bioactive substances from the onion peel also has been attended as the way to utilize or evaluate the abundant parts of the resources. Thus the extraction strategies of valuable elements from the waste of onion ought to be value enough to pursuit in economic purpose and environmental profit as a result of the foremost flavonoids in onion are distributed on the outer skin (peel) [27].

Quercetin contains five hydroxyl groups (Figure 2), which determine the biological activity of the compound and the possible number of derivatives. The major groups of quercetin derivatives that are found in onions are glycosides and ethers. Sulfate and phenyl substituents are found in only small amounts [28].

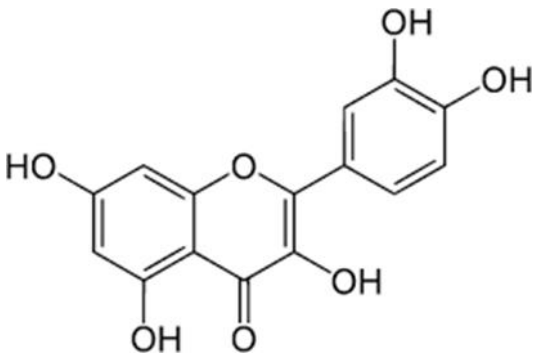

Figure 2 Quercetin

Recently, onion has drawn attention due to its beneficial effects for human health. Besides well-known antioxidant activity, such anticancer properties were revealed as to reduce the carcinogenic activity of several mutagens in cooked foods and to inhibit the enzymatic activities associated with several types of tumor cells. Consequently, there is

increasing demand on the practical method to obtain such bioactive compounds from diverse plant source. To utilize such valuable bioactive compounds in the plants, methods to isolate such substances from the source materials are needed promptly. Therefore, novel techniques like DPPH radical scavenging, total phenol content and total flavonoid tests are carried over.

2. Material and methods

1, 1-diphenyl-2-picryl-hydrazyl (DPPH), 50 mM Tris HCl, Folins Phenol Reagent, Sodium Carbonate solution, $AlCl_3$ solution and Potassium Sodium Tartarate were purchased from sigma Aldrich of analytical grade.

2.1. General procedure

2.1.1. Preparation of Onion Peel Extract

Skins of the red onions were collected from the nearby hotel. The peels were washed, dried at 40 °C and chopped into small tiny pieces. The dried peels were weighed for about 20 g and then 200 ml of distilled water was poured to the onion peels in a beaker and the mixture was boiled for 15 minutes with continuous stirring in order to obtain onion peel extract. The extract is then cooled at room temperature and filtered using Whatman No.1 filter paper. Thus further studies were carried out with the prepared extract from onion peel.

2.1.2. Total Phenol content

Total phenol content was measured by Folin- Coicalteu assay method. The 1ml of the extract was mixed with 0.5 ml of 10% folin-ciocalteu reagent and 2 ml of the 20% Na_2CO_3 solution, the mixture was allowed to mix and incubated in shaking incubator at 45 °C for 15 minutes. After incubation the OD value was measured at 765 nm under spectrophotometer (LABTRONICS LT-291). Gallic acid was used as a standard to calculate the mg/g of the phenol content.

2.1.3. Total Flavonoid Content

Total flavonoids content was determined by spectrophotometrically using the method of aluminium chloride assay. 1ml of the extract was dissolved with 0.1 ml of 10% aluminium chloride solution and 0.1 ml of sodium potassium tartarate followed by 2.8 ml of distilled water. After adding the reagents the tubes were incubated in room temperature for 30 minutes and the measurement was taken in the nanometer of 415 using spectrophotometer (LABTRONICS LT-291). Blank was maintained without adding the sample and standard quercetin was used to calculate the mg/g of the flavonoids content.

2.1.4. 1, 1-diphenyl -2-picryl-hydrazyl (DPPH) Activity

DPPH (2, 2-diphenyl-l-picryl hydrazyl) Radical Scavenging Assay The antioxidant activity of the sample was estimated using the DPPH radical scavenging protocol. DPPH solution (0.004 % w/v) was prepared in 95 % ethanol.

0.1 ml of freshly prepared DPPH solution (0.004% w/v) was added in the test tubes containing different concentration of the sample from 250 µl, 500µl, and 0.4 ml of 50 mM tris HCl solution. The reaction mixture was incubated in the dark for 30 min and thereafter the optical density was recorded at 517 nm against the blank. For the control, 2 ml of DPPH solution in ethanol and the optical density of the solution were recorded after 30 min. The decrease in optical density of DPPH on addition of test samples in relation to the control was used to calculate the antioxidant activity. Standard ascorbic acid was prepared in the concentration of 10 mg/1ml and mg/g of DPPH was calculated.

3. Results and discussion

The food industry produces a large amount of onion waste and there is need to search for possible ways of their utilization. This research has found that onion peel has high content of carbohydrate, flavonoid and phenol. It further revealed that onion peel ethanoic extract could delay oxidation in cooked beef as well as the inhibited growth of some pathogenic bacteria. It may be suggested that after proper cleaning, onion peel may be included in food processing instead of discarding it. Also, further studies should be done to investigate the capability of onion peel to serve as a functional ingredient in food formulations.

From the above conducted tests, we can conclude the amount of DPPH, Total phenol and Flavonoids present in the onion peel. The values are given in table 1.

Table 1 Total phenol and Flavonoids content and DPPH radical scavenging activity of onion peel

Test	Standard	Value
Total Phenol	Gallic acid (C7H6O5)	134 mg/ml
Flavonoid content	Quercetin (C15H10O7)	540 µg/ml
DPPH Radical Scavenging	Ascorbic acid (C6H8O6)	46 mg/g

4. Conclusion

Onion is one of the most important vegetables used worldwide for enhancing the flavor and taste of a diverse variety of foods. Besides this, onion, when eaten raw in salad, plays an important role due to the health benefits accrued by the direct intake of phytochemicals in the raw form. The importance of phytochemicals in curing diverse human ailments marks out the onion as being of great value to the food and pharmaceutical industry. The future of onions in the food industry lies in the development of the elite varieties with a high content of phytochemicals. More research is required for every stage of production, beginning from the farmer's field to the processing center, and suitable technologies must be developed to preserve the valuable phytochemicals for the benefit of human health. The phytochemicals present in onions are biologically active and possess immense health benefits. Onions demonstrate a remarkable variation in the development of phytochemicals of high biological importance, according to the type of variety and the geographical area where they were grown. A suitable breeding strategy for the development of onion varieties possessing ample amounts of phytochemicals should be developed. The impact of preharvest practices adopted on the farm must be studied, and biotic and abiotic stresses, which reduce the endogenous synthesis of phytochemicals, must also be studied thoroughly. Development of processable varieties of onions, along with standardized procedures for processing and engineering technology, is the need of the hour; this, in turn, will boost the development of onion-based processed products by simultaneously keeping the phytochemicals in a stable form. The phytochemicals in onions need to be preserved by developing a quality based methodology for processing raw onions. There is a scarcity of scientific information regarding the impact of postharvest processing methods on the phytochemicals present in onion. Further research is also needed on the impact of preharvest practices on the development of phytochemicals, which has so far not been explored thoroughly.

Compliance with ethical standards

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Disclosure of conflict of interest

The authors declare no conflict of interest.

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