

Phytochemical Significance of Selected *Allium cepa* Varieties—A Review

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Abstract

Herbal medicines as the major remedy in traditional system of medicine have been used in medical practices since antiquity. Medicinal plants have been used from the rural dwellers throughout the world. A medicinal plant is any plant which, in one or more of its organs, contains substances that can be used for therapeutic purposes, or which are precursors for chemo-pharmaceutical synthesis. Such a plant will have its parts including leaves, roots, rhizomes, stems, barks, flowers, fruits, grains or seeds, employed in the control or treatment of a disease condition and therefore contains chemical components that are medically active. The study of natural products on the other hand is called phytochemistry. Phytochemicals are complex group of primary metabolites and secondary metabolites. Primary metabolites are essential for plant's growth and reproduction while secondary metabolites if present may have significant effects. Now-a-days it is clearly known that they play roles in the protection of human health, when their dietary intake is significant. *Allium* species are believed to possess medicinal properties including antioxidants. The bulb of onion is used medicinally and onion has been consumed as food for many centuries. The generated data from the three

different extracts of *Allium cepa* varieties provided the basis for its wide uses in the traditional and folk medicines.

Keywords- : Phytochemistry, *Allium*, Herbal, Metabolites, Phytochemicals.

Introduction

Since ancient times, onions (*Allium cepa* L.) have been an important dietary resource and have also been of interest for medical purposes (Rose *et al.*, 2005). Traditionally, onions and plants belonging to the *Allium* genus have been used as an herbal remedy for a wide range of ailments, due to their association with many pharmacological effects. Onion is known for being a good natural source of flavonoids mainly represented by the flavonols - quercetin and kaempferol, which are present as their glycosides. In recent years, many publications have reported evidence of beneficial health effects attributed to flavonoids including antiallergenic, anti-inflammatory, cardio protective, anticarcinogenic and antioxidant properties. Several epidemiological studies have also associated the consumption of flavonoids with a reduction of the risk of chronic diseases including, cancer, diabetes and coronary heart problems (Ponnulakshmi R *et al.*, 2013).

In addition, onions contain hydroxyl benzoic acids, protocatechuic acid, phloroglucinol acid and pyrocatechol. A large number of diseases such as asthma, arthritis, cancer etc. can be cured not only through pharmaceuticals chemicals but also by plant based drugs without any side effects.

An onion is an herbaceous biennial plant. It is included in Liliaceae family. It is grown for its edible bulb. It is a vegetable and widely cultivated species of the genus *Allium* (Boyhan GE and Kelley WT, 2008; Drost D, 2004; Schwartz, 2008). The height of the onion plant is 15-45 cm (6 to 18 inches). The stem of the plant is a flattened disc at the base and the tubular leaves form a pseudo stem where their sheaths overlap. The leaves are yellowish to bluish green and grow alternately in a flattened, fan shaped swathe. The leaves are either erect or oblique and there are 3-8 per plant. The leaves are fleshy, hollow and cylindrical with one flattened side. The ending portion of it is like blunt ends. The base of each leaf is flattened, usually white sheath that grows out of a basal disc. From the underside of the disc, a bundle of fibrous root extends for a short way into the soil. As the onion matures food reserves begin to accumulate in the leaf bases and the bulb of the onion swells (Brickel, 1992).

The bulb of the onion is made up of several layers, each corresponding to a leaf. They are generally oval but shape can be variable and occur in clusters of 3-18 to a plant. The bulb is protected by a membrane which turns to a papery coat. The onion plant produces pink or white flowers clustered on stalks. The floral stalk is rigid, hollow and waxy and the plant is over a meter tall, with an umbrella inflorescence and spherical shape. The hermaphrodite flowers are white, the fruit is a capsule. Reproduction occurs through the glossy black seeds (triangular in cross section) (Boyhan GE and Kelley WT, 2008; Drost D, 2004; Schwartz, 2008).

Phytochemicals

Phytochemicals (from the Greek word phyto, meaning plant) are biologically active and naturally occurring chemical compounds which are found in plants and provide health benefits for humans further than those attributed to macronutrients and micronutrients. They protect plant from disease and damage and contribute to the plant's color, aroma and flavor. In general, the plant chemicals that protect plant cells from environmental hazards such as pollution, stress, drought UV exposure and pathogenic attack are called as phytochemicals. Recently, it is clearly known that they have roles in the protection of human health, when their dietary intake is significant (Mamta S *et al.*, 2013).

Primary and Secondary Metabolites

Phytochemicals are classified as primary or secondary constituents, depending on their role in plant metabolism. It is said that primary metabolites are essential in plant growth and reproduction. In the absence of these that processes do not occur properly. While secondary metabolites are not as essential as primary. But primary metabolites have their particular role in living organisms. Primary metabolites include the common sugars, amino acids, proteins, purines and pyrimidines of nucleic acids, chlorophylls etc. Secondary metabolites are the remaining plant chemicals such as alkaloids, terpenes, flavonoids, lignans, plant steroids, curcumines, saponins, phenolics, flavonoids and glycosides.

Phenolics

Phenolics phytochemicals are the largest category of phytochemicals and the most widely distributed in the plant kingdom. The three most important groups of dietary phenolics are flavonoids, phenolic

acids, and polyphenols. They are aromatic compounds containing benzene ring and one or more hydroxyl groups produced by plants which are responsible for protection against stress. The function of phenolic compounds in plant physiology and interactions with biotic and abiotic environments are difficult to overestimate.

It plays an important role in plant development, particularly in lignin and pigment biosynthesis and provides structural integrity and support to plants. Importantly, phenolic phytoalexins, secreted by wounded or otherwise perturbed plants, repel or kill many microorganisms and some pathogens can counteract or nullify these defenses or even subvert them to their own advantage (Bhattacharya *A et al.*, 2010). They are generally known for their free radical scavenging activity, which depends on the structure, the number and positions of the hydroxyl groups and the nature of substitutions on the aromatic rings. Fruits, vegetables and beverages are the major sources of phenolic compounds in the human diet (Nagendran B *et al.*, 2005).

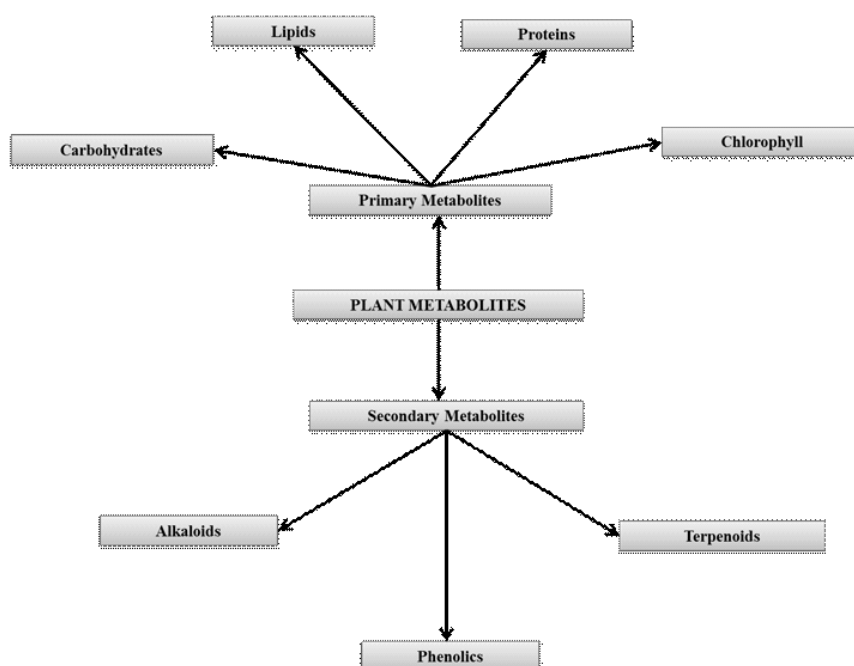


Fig. 2 Formation of Phytochemicals

Materials

Scientific Name: - *Allium cepa* L. (from Latin *cepa* "onion")

Family: - Liliaceae

Common Name: - Onion, Dungali, Kanda, Pyaj

There are many varieties of onion available in the market. These varieties are classified on the basis of their shape, size, color, pungency or their maturation habits. ICAR documented important varieties under the All India Co-ordinated Vegetable Improvement Project, which are given below:-

1. Red onion: Seven varieties of red onion are known. Some of them are given below,

a) Pusa Red: This type of onion variety is having medium size bulb, purple red in color, weighs 70-90 gms. It has poor pungency. India is known for growing this type of onion largely.

b) Agri Found Dark Red: This variety has dark red bulb, medium pungency and round in shape. It is kharif season crop and having storage capacity.

2. White onion: Six varieties of white onion are known. Some of them are given below,

a) Pusa White Round: This variety has white bulb, round in shape, long as 4.65 cm and wide as 6.21 cm.

b) S-48: This type is having good keeping quality, flavour and texture. Bulb is flat round in shape.

Seven new improved onion varieties have been developed by National Research Centre for Onion and Garlic. They all are having high yield and quality potential.

They are: Bhima Raj, Bhima Red, Bhima Super, BhimaKiran, Bhima Shakti, BhimaShweta, Bhima Shubra

Red coloured bulbs: Punjab Selection, N-2-4-1, PusaMadhavi, ArkaNiketan, ArkaKalyan, AkraPragati, N-53, Baswant-780, and Udaipur 101

Yellow coloured bulbs: Early Grano, Spanish Brown and PhuleSuvarna

White coloured bulbs: Udaipur 102, PhuleSafed and N-257-9-1

Small common onion: Agrifound Rose and ArkaBindu

Multiple onion: Co-1, Co-2, MDU-1 and Agrifound Red

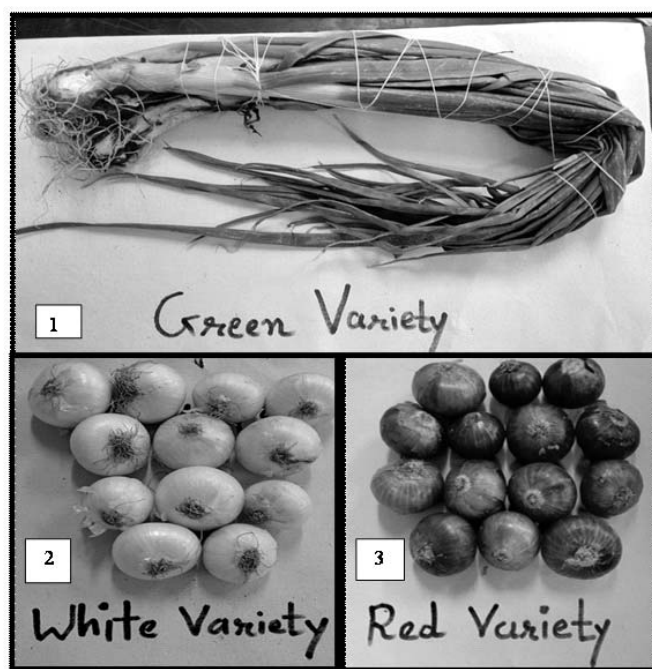


Fig.1: Different varieties of *Allium cepa* species

Plant Description

Spring Onion: The plant is native to Central Asia. It is also called scallions and green variety, are young onions harvested when their tops are green and the underdeveloped bulbs are 13mm (0.5inch) or less in diameter having a mild flavor. The entire onion, including top, stem and bulb, is used raw in salads and sauces, as a garnish and as a seasoning for prepared dishes (Fig.1.1).

White variety: The plant is native to Central Asia. It has a thin, dry paper sheath with a crisp translucent pearl white flesh which is pungent, savory and warm. Its barely sweet finish can be attributed to its higher moisture content than yellow onions. It is used in Mexican foods or complementing the flavors of other ingredients. It can be sauteed to a dark brown color and served to provide a sweet and sour flavor to other foods (Fig. 1.2).

Red variety: It is a native plant of Southwestern Asia. It found to flourishly grow in three distinctly different regions, Turda in Romania, Tropa in Italy and Wethersfield, Connecticut within the United States. Red onions are shallow-rooted and need a friable soil that retains moisture well, especially

after cultivation (Laura G *et al.*, 2002). They are often consumed raw, grilled or lightly cooked with other foods or added as a decoration to salads. They tend to lose their color when cooked and are available throughout the year. The red color comes from anthocyanidins such as cyanidin and it contains high amount of flavonoids. They can be stored for 3 to 4 months at room temperature. They are used in various ways like culinarily, non-culinarily and medicinally (Fig. 1.3).

Uses

Historical Uses:

- In ancient Greece, athletes ate large quantities of onion because it was believed to lighten the balance of blood.
- Roman gladiators were rubbed down with onions to firm up their muscles.
- In the middle Ages, onions were such an important food that people paid their rent with onions and even gave them as gifts.
- Doctors were known to prescribe onions to facilitate bowel movements and erections and in relieving headaches, coughs, snakebite and hair loss. Onions were also prescribed by doctors in the early 16th century to help with infertility in women (Robertson *et al.* 1998).

Culinary Uses:

- Onions are commonly chopped and used as an ingredient in various hearty warm dishes and may also be used as a main ingredient in their own right, for example in French onion soup or onion chutney.
- They are very versatile and can be baked, boiled, braised, grilled, fried, roasted, sautéed or eaten raw in salads.
- Onions are a staple in Indian cuisine, used as thickening agent for curries and gravies. Onions pickled in vinegar are eaten as a snack.
- Young plants may be harvested before bulb is produced and used whole as spring onions (Rodriguez *et al.* 2008).

(a) Non-culinary Uses:

- It is used in education purpose for observing cell structure, because cells of onions are large and easily observed as separate layers.
- The pungent juice of onions has been used as a moth repellent and can be rubbed on the skin to prevent insect bites. It has been used to polish glass and copperware and to prevent rust on iron.
- Onion skins have been used to produce a yellow-brown dye (Roldan *et al.* 2010).

(b) Medicinal Uses:

- It is used in wound treatment because it has mild antimicrobial qualities.
- European, Asian and Native American medicines are filled with onion. Some of them include cough relief during colds and their use as poultices drawing poisons from wounds and ulcers.
- Even in relatively modern times, onion poultices are used on the soles of the feet to reduce high fevers or placed on the chest to relieve congestion. One ancient remedy included onion tea to relieve cholera, fevers and headaches, as well as being treatments for gout, arthritis, soothing burns, and speeding healing.
- Modern research is proving that eating onions and garlic reduces LDL (low density lipoprotein) or cholesterol, responsible for clogging the arteries. These anti-clotting properties make them doubly helpful to the circulatory system. Onions have also been known to lower blood sugar levels, and they have readily demonstrated their antimicrobial properties.
- Onions also have substances called saponins that fight against cancer. To put it simply saponins help the cell DNA to stop producing bad cells and make only good ones. Onions can help fight off bacteria, fungi and viruses in the body.
- Chewing raw onion for at least three minutes is said to kill any bacteria in the mouth that might be causing toothaches or the gums to bleed. Putting a slice of onion directly on an

insect bite will cut down on the itching and prevent infection (Joseph MD and Amy RA, 2013).

- In North America, Native Americans used onion to treat insect stings and relieve colds. It is also used in traditional Chinese medicine. Homeopaths make a tincture of onion to treat a variety of conditions including cold, cough, diarrhea, facial paralysis, hay fever, hernia, laryngitis, pneumonia and trauma. Over the centuries onion has been used for healing both internally and externally. Internally onion has been recommended to treat colds, cough, bronchitis, whooping cough, asthma and other respiratory problems. It is believed to help loosen congestion in the lungs and expand the airways. Onion is also used internally to relieve excess gas and calm an upset stomach. Onion is also thought to stimulate the appetite (Sengupta *et al.* 2004).

Allium cepa varieties: (Green onion, Red onion, White onion)

Allium cepa varieties belong to *Allium* Species were focused here which includes green onion, red onion and white onion. The science of application of these indigenous or local medicinal remedies including plants for treatment of diseases is currently called ethno pharmacology but the practice dates back since antiquity (Doughari JH, 2012). According to previous research, *Allium cepa* varieties are meant to possess anti-bacterial and anti-fungal activities and they contain the powerful antioxidants, sulfur and other numerous phenolic compounds which have aroused great interests for food industries. During the last 20 years, *Allium cepa* varieties have been among the most studied vegetables and aroused great interest. One of the advantages of these Onion Varieties is that they could be dried and preserved for several months. On the other hand, *Allium cepa* varieties contain other antioxidant components, such as flavonoids and volatile sulfur compound. According to previous study it is well known that onion is a great source of phenolics.

Conclusion

According previous study we can say that the metabolites present in the three selected *Allium cepa* varieties are alkaloids, tannins, phenols, flavonoids, saponins, terpenes, carbohydrates and proteins except cardiac glycosides. In addition to that the main group of phytochemical which is present widely includes phenolics. The presence of these secondary metabolites gives large scope

for the separation and isolation of various phytoconstituents for studying their bio-efficacy.

References

Boyhan GE & Kelley WT (Eds.) (2008). *Onion production guide. University of Georgia Cooperative Extension.*

Drost D (2004). Onions in the garden. Utah State University Cooperative Extension.

Schwartz HF and Mohan SK (Eds.) (2008). *Compendium of Onion and Garlic Diseases and Pests. Second Edition. American Phytopathological Society Press.*

Brickell and Christopher (ed) (1992). *The Royal Horticultural Society Encyclopedia of Gardening. Dorling Kindersley. p. 345.*

Doughari JH (2012). *Phytochemicals: Extraction methods, basic structures and mode of action as potential chemotherapeutic agents. INTECH Open Access Publisher.*

Ponnulakshmi R and Balasubramanians E (2013). Efficacy of bulb extracts of *Allium cepa* varieties (Red, White and Small Onion): An in vitro antifungal and antioxidant activity. *International Journal of Pharma and Bio Sciences.* 4(4): 692-713.

Sahira Banu K and Cathrine L (2015). General Techniques Involved in Phytochemical analysis. *International Journal of Advanced Research in Chemical Science (IJARCS).* 2(4): 25-32.

Mamta S, Jyoti S, Rajeev N, Dharmendra S and Abhishek G (2013). Phytochemistry of Medicinal Plants. *Journal of pharmacognosy and Phytochemistry.* 1(6): 168-182.

Bhattacharya A, Sood P and Citovsky V (2010). The roles of plant phenolics in defence and communication during *Agrobacterium* and *Rhizobium* infection. National Centre for Biotechnology and Information. PubMed.

Nagendran B, Kalyana S and Samir S (2006). Phenolic compounds in plants and agri-industrial by-products: Antioxidant activity, occurrence and potential uses. *ELSEVIER Journal of Food Chemistry.* 99(1): 191-203.

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