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Review: (*Allium cepa*) to study phytochemistry and health benefit

Hema Barti, Gauri Shankar and Sony Singh

Abstract
The herbal plants are used as a traditional medicine in Ayurveda. According to Ayurveda system plant contains many chemical constituents that can be used as a treatment for many diseases. In the present scenario, herbal medications have increased worldwide importance with both therapeutic and practical ramifications. It is the most cultivated herb over all the word. *Allium cepa* (onion) bulb is widely used as an edible and it is easily available in our kitchen and also used as a drug for health benefits. Traditionally it is used for the treatment of cold, cough, metabolic disorder, skin disease, insect bite, pneumonia, urinary system disorder, ear disorders, sexual disability, and also as a wound healer from ancient times. Nowadays, it is used as medicine. Onion has been containing many chemical constituents such as flavonoids, alkaloids, saponins, organosulfur compounds, glycosides as well as vitamin-C & B6, minerals, fiber, fat, Carbohydrate, and Potassium is also found. Major flavonoids present in *Allium cepa are* Quercetin, quercetin glucosides, quercetin -3, 4-di glucosides, and quercetin - 4- glucosides responsible for many of its medicinal properties. The pharmacological activities of *Allium cepa* have been determined by research as include antioxidants, antifertility, anticarcinogenic, analgesic, antiplatelet, anti-inflammatory, anti-hypertensive, diuretic, fibrinolytic, antihelminthic, hypolipidemic properties, anti-diabetic, immunoprotective effect, and cardiovascular disease. It containing several biological potencies such as antibiotic effect. Nowadays various formulation of *allium cepa* is available in the market as a polyherbal formulation and single herbal formulation in Ayurveda. The main focus of this review is to extend an overview of the studies regarding the phytochemistry, Pharmacological activities, and health benefits of *Allium cepa*.

Keywords: *Allium cepa*, phytochemistry, pharmacological properties

Introduction
Allium cepa is one of the most common bulb of the Alliaceae family usually known as onion which is extensively cultivated vegetable in the world [1]. The origin of the onion is from central Asia (present-day Iran-Pakistan region). Since ancient times as mentioned in Ayurveda about its use, it was considered to be the most admired vegetable. This was first identified and cultivated in 1629 at that instant its distribution was only in the temperate region but now it has extended to other parts of the world especially to South America, Asia, and Africa [2]. It is a perennial herb. Onion produces a pungent flavor and aromaticity due to the presence of sulfur compound present in this and constituting different colors that are red, white, yellow. *Allium cepa* is commonly known by several alternative names such as Rasona, piyas, piyaz, Kanda, Maharu, durgandha in various parts of our country [3, 4]. All parts of this plant-like bulb, leaves, flower, and its volatile oil are used for various purposes. It is single of the ancient cultivated vegetables widely grown in the world. Besides its use in vegetable form, it is also used as a primary source as a flavor agent, condiment as well as medicine in the various industry and provides the nutritive value of several compounds like carbohydrate, protein, fat, vitamins, minerals, sugars, fibers, etc. *Allium cepa* contains several other secondary chemical constituents like quercetin, di, tri – sulfides folic acid, glycoside, alkaloid, saponin, tannin, etc [4, 5, 6]. Traditionally, it is used for the treatment of disability of our body or disease like cold cough diuretic, metabolic disorder, skin disease, insect bite, pneumonia, urinary system disorder, ear disorders, sexual disability, and also as a wound healer [7]. The pharmacological activities of *Allium cepa* include antioxidants, antifertility, analgesic, anticarcinogenic, antiplatelet, antihelminthic, antibiotic anti-inflammatory, anti-hypertensive hypolipidemic, antimicrobial, anti-diabetic. Apart from this, it acts as immunoprotective and also provides a cure for various cardiovascular-related diseases [7, 8, 9]. *Allium cepa* has been deeply investigated on basis of its Phytochemical constituent and along with its biological properties. The main focal point of this review is to show, present, and comprehensive overview of the latest studies related to *allium cepa* against its use for different health benefits.

Taxonomical classification:
Kingdom: Plantae Plant
Phylum: Magnoliophyta
Class: Liliopsida
Order: Asparagales
Family: Alliaceae
Genus: Allium
Species: *Allium cepa*

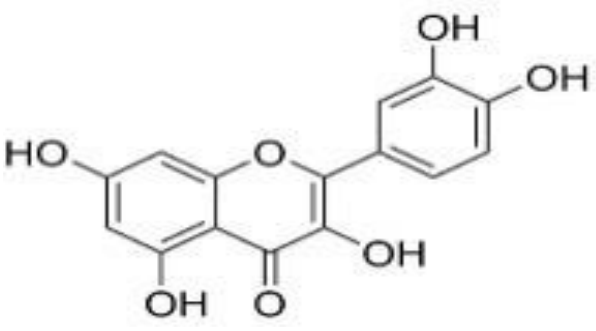
Morphology
Appearance: Solid bulb shape
Odour: Distinctive
Colour: Red, White, Purple
Taste: Pungent

Phytoconstituents
Phytoconstituents of *Allium cepa* contain sugar, water, Protein, Carbohydrate, Minerals, Fiber, Vitamins, Fat, and they also contain various secondary metabolites like Flavonoids (Quercetin, Kaempferol, Anthocyanins) compound, and Volatile and non-volatile organosulfur compound and sterols, Saponins [1, 8].

1. Based On Its Constituents in *Allium cepa* L.
(A) Flavonoid content of onions (*Allium cepa* L.)
Several studies on the flavonoid content of onion have shown several flavonoids such as Quercetin, Kaempferol, and Anthocyanin [10, 11, 12].

(1)Quercetin: It is the important compound its representative of polyphenols, flavonoids. Quercetin is found in plants in several glycosidic forms. It is normally present in conjugated with sugars such as Rhamnose, Glucose, Galactose [11, 12]. Thsese glycosidase present in Abaxis epidermis of scale. Quercetin rich source in onion as well as other vegetables such as Tomatoes, Garlic, Green peppers, Asparagus, etc. Quercetin present in the outer part of the onion. And this quercetin is further categorized into quercetin-4-glucoside, quercetin-3, 4'-diglucoside, quercetin-7, 4'-diglucoside and isorhamnetin glycoside [13, 14, 15].

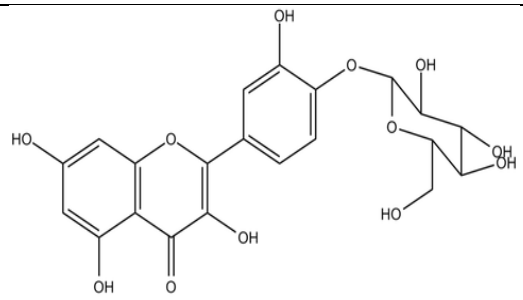
Table 1: Chemical structure of Quercetin and its derivative



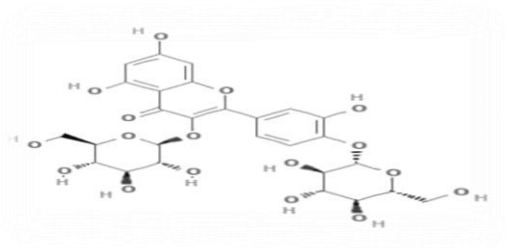
Quercetin

Pharmacological uses- [16, 17, 18]

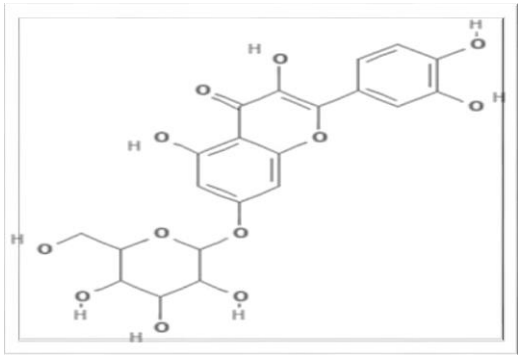
- Its use as an Antioxidant
- Antiviral
- Anticancer
- Antimicrobial
- Anti-inflammatory
- Hepatoprotective activity
- Cardiovascular protection
- Neurological effect
- Antidepressent effect
- Antiallergic
- Antiplatelet



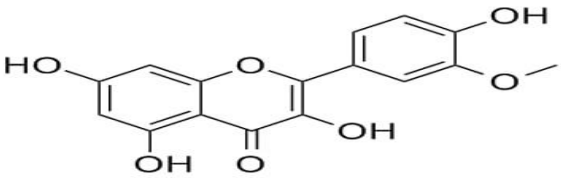
Quercetin-4-glucoside



Quercetin-3, 4'-diglucoside



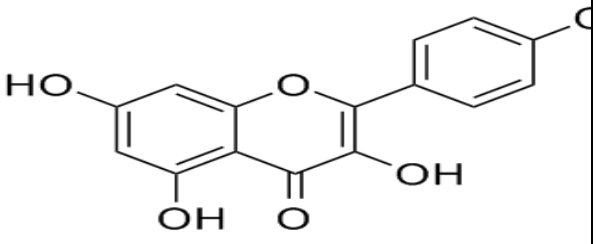
Quercetin-7, 4'-diglucoside



Isorhamnetin glycoside

(2) Kempferol, - It found in less quantity than quercetin and anthocyanin. Kempferol is further subdivide into Kaempferol-4´-glucoside, Kaempferol-7, 0-glucoside, Kaempferol-3-glucoside, Isorhamnetin-4´-glucoside [11, 13, 15].

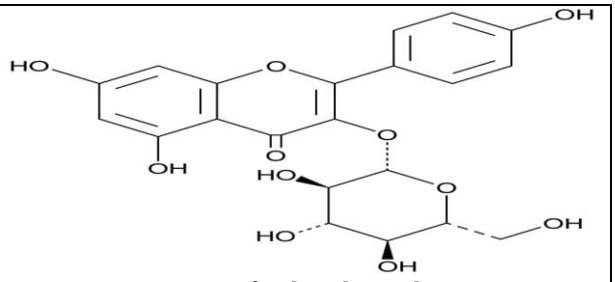
Table 2: Chemical structure of Kaempferol and its derivative



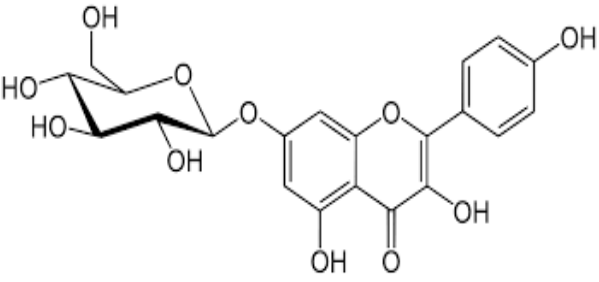
Kaempferol

Pharmacological uses- [19]

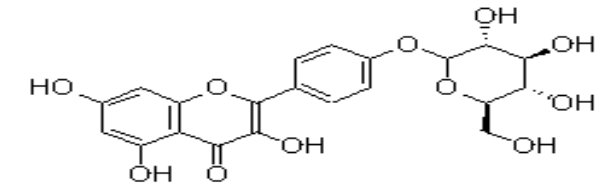
- Anticancer
- Anti-inflammatory
- Hepatoprotective
- Diabetes
- Cardiac vascular system



Kaempferol-3-glucoside



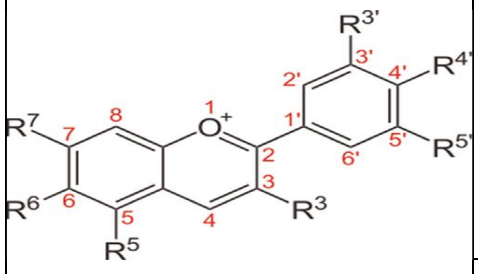
Kaempferol-7, 0-glucoside



Kaempferol-4´-glucoside

(3) Anthocyanins – It is the minor constituent of red onion but it also presents in yellow and white onion. They have a three aromatic ring molecules region attached with one or more sugar molecules. Anthocyanin is further divided into Peendin-3´-glucoside, Petanidin-3´-glucoside acetate, Delphinidin-3´-glucoside, Malvidin-3´-glucoside [13, 21].

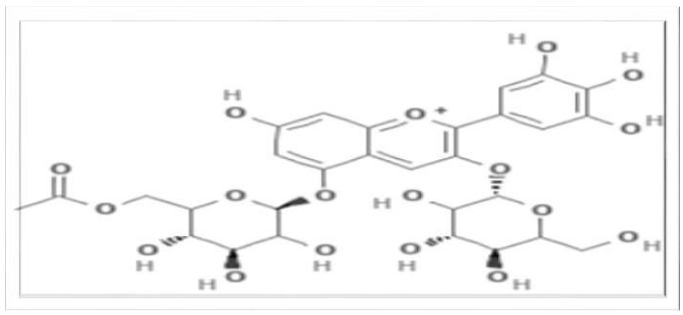
Table 3: Chemical structure of Anthocyanins and it's derivative



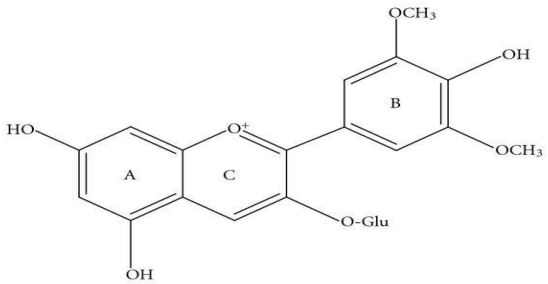
Anthocyanin

Pharmacological uses- [22, 23]

- It uses as an antioxidant
- Anti-inflammatory
- CNS activity



Delphinidin-3´-glucoside



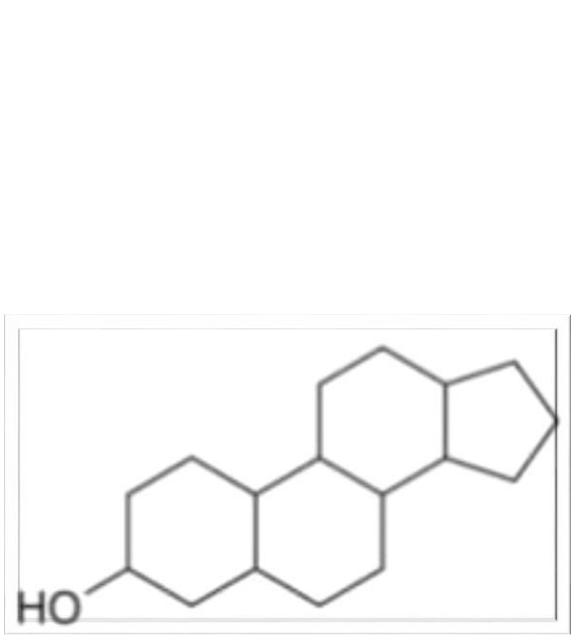
Malvidin-3´-glucoside

(B) Sterols content of onions

The content of sterols and their glycosides has been determined in leaves and bulbs of *Allium cepa* In bulbs, the amount of these sterol derivatives was lower compared with leaves.

The main sterols are – cholesterol, stigmasterol, β-sitosterol, cycloartenol, campesterol, 24-Methylenecycloartanol, 31-Norcycloartenol, 28-Isofucosterol, Cholest-7-enol, Lophenol, & δ-7-Stigmasterol, δ-5-Avenasterol, Brassicasterol [24, 25].

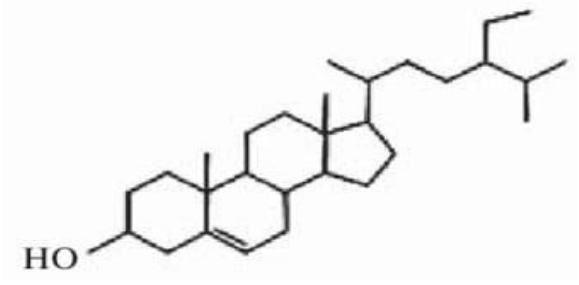
Table 4: Chemical structure of Sterols and its derivative



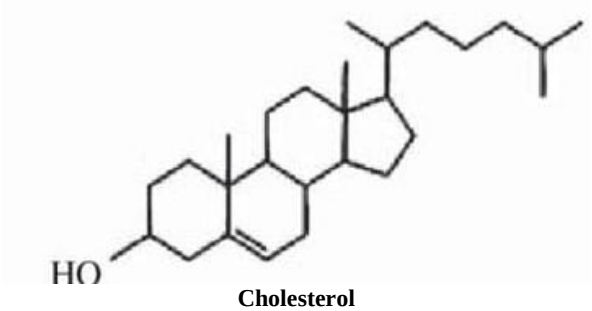
Sterols

Pharmacological uses- [26, 27]

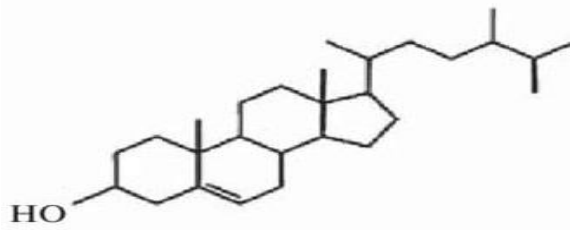
- It is used as an Anti-tumour
- Hypoglycemic
- Anti-hypercholesterolemic activity
- Cytotoxic
- Antimicrobial
- Antioxidant



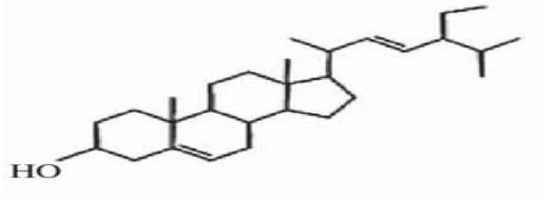
β- sitosterol



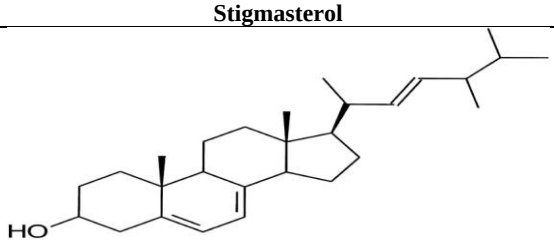
Cholesterol



Campesterol



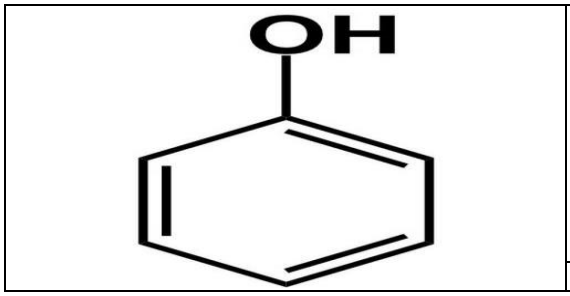
Stigmasterol

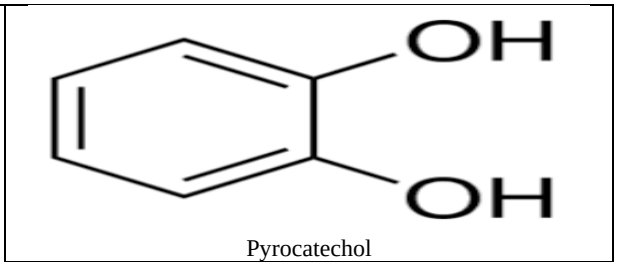


Ergosterol

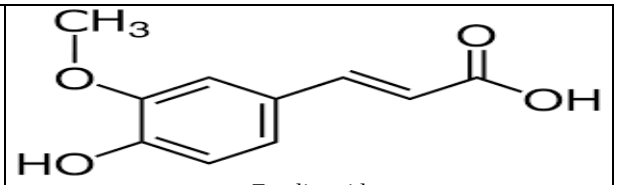
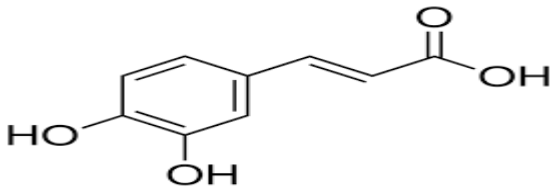
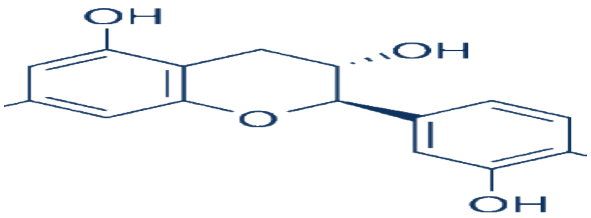
(C) Phenolic compound: It also is known as a secondary metabolite more than 800 phenolic compounds are naturally occur and a recent study concerning phenolic compounds as the potential source of pharmaceutical and medical application. It contains Ferulic acid, Caffeic acid, Catechuic acid, Pyrocatechol, Phloroglucinol, Phloroglucino carboxylic acid, Methyl ester of phloroglucinol carboxylic acid. [13, 16].

Table 5: Chemical structure of Phenolic and its derivative





Pyrocatechol

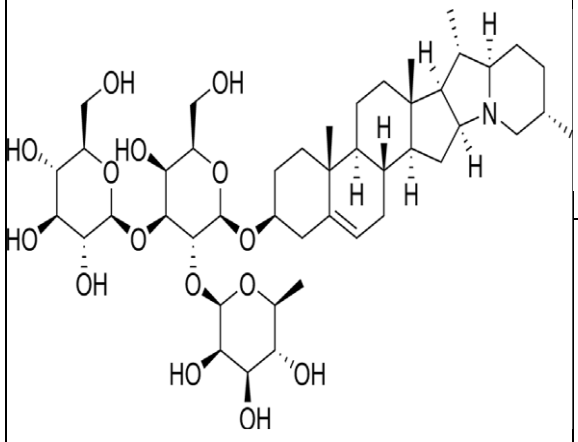
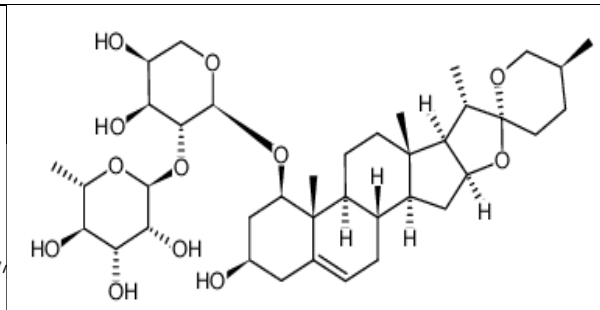
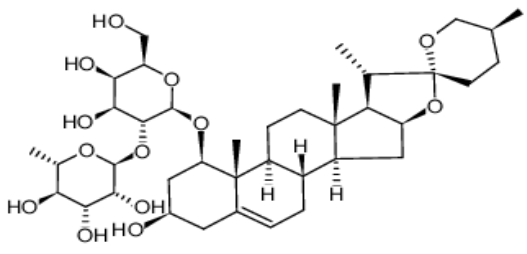
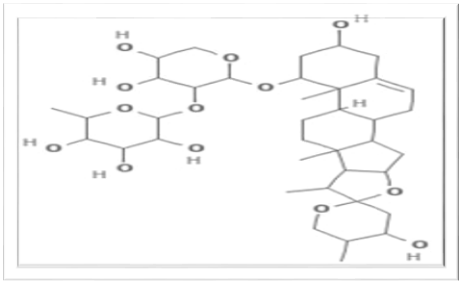
Phenol **Pharmacological uses-** [26] • Antioxidant effect • Anticancer effect • Antibacterial effect • Cardioprotective effect • Anti-inflammatory effect • Skin protective effect	 Ferulic acid  Caffeic acid  Catechuic acid

(D) Saponins it is the most common compound in the Liliaceae family. It is mainly found in red onion. It is the amphipathic glycoside with foaming nature in this lipophilic triterpene derivative with one or more hydrophilic glycoside moieties [27, 28].

Some of the common compound in Alliaceae family which categories as

- **Spirostanol type** (Alliospiroside A, Alliospiroside B, Alliospiroside C)
- **Furostanol type** (Tseposides E, F, Alliofuroside A)

Table 6: chemical structure of Saponins and it's derivative

 **Saponin** **Pharmacological uses-** [29, 30] • It uses as an anti-inflammatory, • Ion channel blocking, • Immune stimulating, • Antifungal, • Antithrombotic, • Antispasmodic	 Alliospiroside A  Alliospiroside B  Alliospiroside C

(E) Organosulfur compound

It's mainly present in Allium vegetables which are either lipid or water-soluble are considered responsible for the beneficial effect of these herbs. Its especially characterized by a high content of both volatile and non-volatile organosulfur compounds [8, 13, 30, 31].

This containing volatile and Non-volatile compound which is -

- Volatile sulfur-containing compounds are Thiosulfinate, Cepaenes, (Z)Propanthial-S-oxide, Thiosulfonates, Disulfides, Monosulfide, Trisulfide, Zwiebelanes.
- Non-Volatile sulfur-containing a compound of the unsubstituted S-containing amino acid –L- cysteine, L-cystine, and L-methionine.

Pharmacological uses [32, 33]

- Atherosclerosis
- Antiviral
- Hepatoprotective
- Anti-inflammatory
- Diabetes

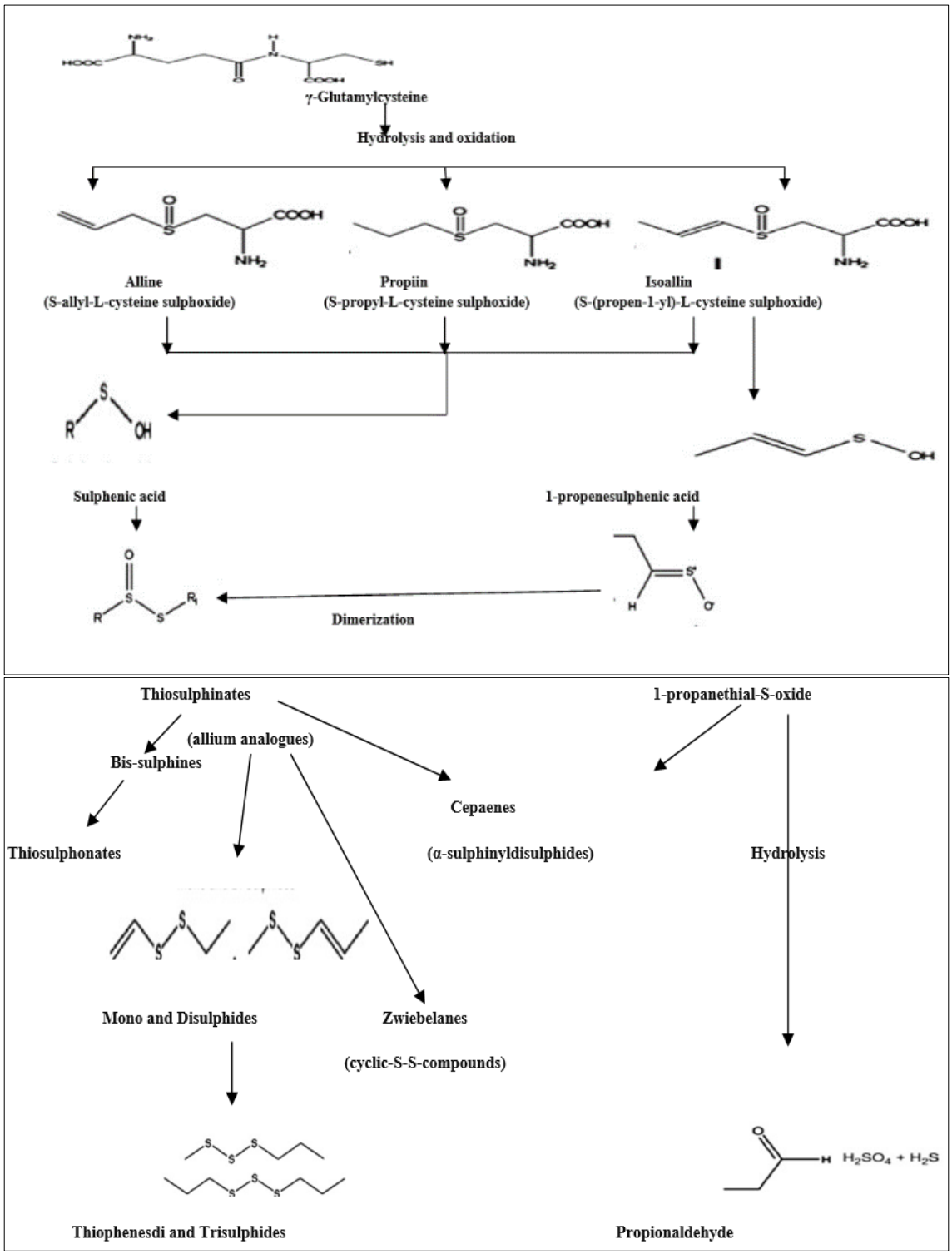


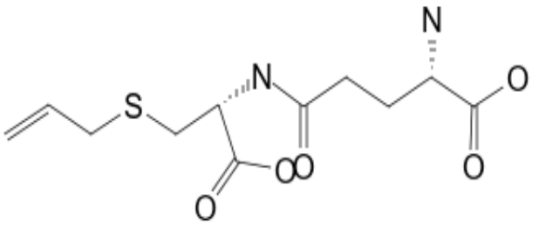
Fig 1: organosulfur compounds throughout the metabolic pathway in process onion

(F). γ -Glutamyl peptide: It is a Gamaglutamyl-peptides is a small molecules peptide it has sensory characteristics and their potential functional properties in the CasR activation. Gamma glutamyl-peptides have been detected in numerous foodstuffs that including edible legumes, Alliaceae, and fermented food. 14 types of Gama glutamyl peptides have been identified in onion [8, 34].

It contains as follows-

- **γ-Glutamyl peptides-** γ-Glutamyl-isoleucine, γ-Glutamyl-leucine, γ-Glutamyl-valine, γ-Glutamyl-thyrosine, γ-Glutamyl-phenylalanine.
- **Sulphur-containing γ-Glutamyl peptides-** γ-Glutamyl-S-methyl-L-cysteine, γ-Glutamyl-S-methyl-L-cysteine sulphoxide, γ-Glutamyl-methionine, γ-Glutamyl-S-trans-(1-propenyl)-L-cysteine-sulphoxide, γ-Glutamyl-S-(2-carboxypropyl)-cysteinyl glycine, Glutathione-cysteine-disulphide, Glutathione-γ-glutamyl-cysteine-disulphide, S-Sulphoglutathione, Glutathione.

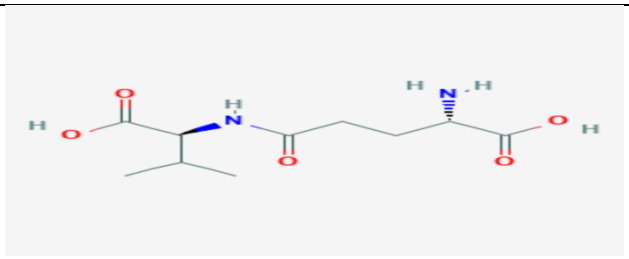
Table 7: chemical structure of the γ-Glutamyl peptide and its derivative



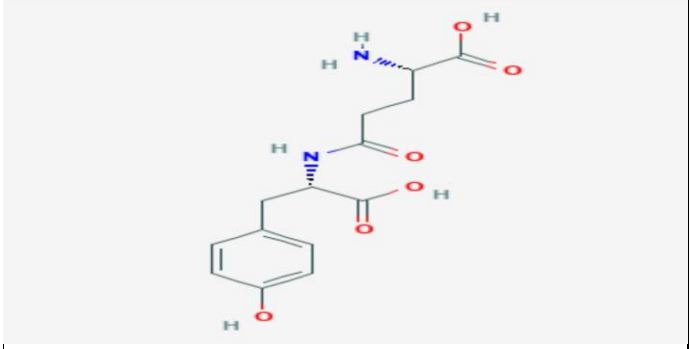
γ-Glutamyl peptides

Pharmacological uses-[35]

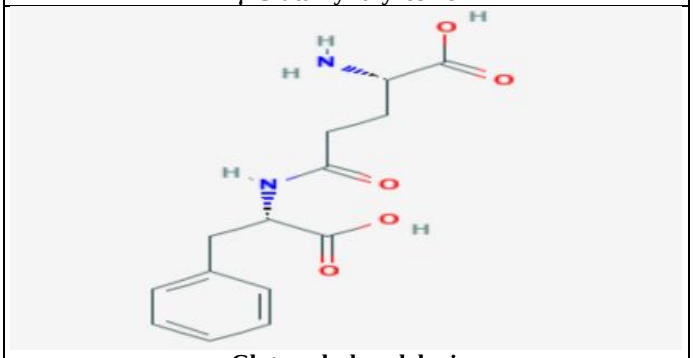
- Immunomodulator
- Anti-tuberculosis therapy
- Anti-inflammatory
- Anti-bacterial
- Neuroprotective
- Memory enhancer



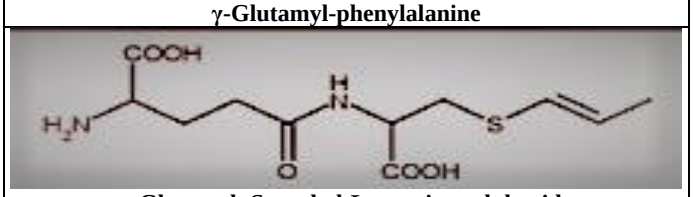
γ-Glutamyl-valine



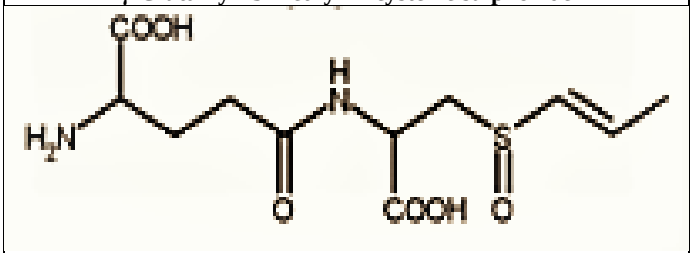
γ-Glutamyl-thyrosine



γ-Glutamyl-phenylalanine



γ-Glutamyl- S-methyl-L-cysteine sulphoxide



γ-Glutamyl-S-trans-(1-propenyl)-L-cysteine-sulphoxide

Nutrients present in *Allium cepa* L.

Table 8: Nutritional value of *allium cepa* per 100g [1, 7, 36]

Constituents	Unit	Value
Water	G	89.1
Energy	Kcal	40.0
Proteins	G	1.1
Total Lipid(fat)	G	0.1
Carbohydrate	G	9.3
Fiber	G	1.7
Sugar	G	4.2

Table 9: Minerals [1, 7, 36]

Constituents	Unit	Value
Calcium (Ca)	Mg	23.0
Phosphorus(P)	Mg	29.0
Potassium(K)	Mg	146.0
Iron (Fe)	Mg	0.2
Sodium(Na)	Mg	4.0
Magnesium(Mg)	Mg	10.0
Zinc (Zn)	Mg	0.2

Table 10: Vitamins [1, 5, 36]

Constituents	Unit	Value
Total ascorbic acid	Mg	7.4
Thiamin	Mg	0.046
Riboflavin	Mg	0.027
Niacin	Mg	0.116
Vitamin (B6)	Mg	0.120
Folate	µg	19.0
Vitamin (A)	IU	2.0
Vitamin (E)	Mg	0.0
Vitamin (K)	µg	0.4

Table 11: Lipid [1, 36]

Constituents	Unit	Value
Fatty acid(Total saturated)	G	0.042
Fatty acid(Total monosaturated)	G	0.013

On basis of phytochemical screening *Allium cepa* L.

Various phytochemicals identify by qualitative chemical tests. Various phytoconstituents present in the extract of *Allium cepa* L. Phytochemical screening are determined and investigated various phytoconstituent using a different organic solvent such as methanol, ethanol, Aqueous. Phytochemical screening showed that the bulb extract of *allium cepa* contains Flavonoids, Terpenoids, Glycosides, Saponins, Fructan, Alkaloid, Glycoside, Saponin, Tannin, Anthocyanin, Organosulfur compound, etc [37, 38,].

Preparation of extract

Allium cepa powder materials were collected and loaded in the extractor (Soxhlet extractor, Maceration) in solvent (ether, chloroform, alcohol, and chloroform water I.P.

Table 12: Methods [38, 39, 40, 41]

Secondary metabolites	Reagents	Appearance
Sterols	Chloroform Acetic anhydride Concentrated sulfuric acid	Purple ring turning to blue after than green
Phenolic compounds (ferric chloride test)	5% ferric chloride	Dark green color shows phenolic compounds
Flavonoids	Isoamyl alcohol, Hydrochloric acid (HCl), Magnesium shavings	Purplish coloration cherry red
Glycosides	Glacial acetic acid, Ferric chloride, Sulphuric acid	Reddish-brown
Terpenoids	Acetic anhydride, Chloroform Concentrated sulfuric acid	Raddish color shows terpenoids
Saponins (forth test)	Distilled water	Forth formation shows the presence of saponins
Anthraquinones	Sulphuric acid, Chloroform (dil.) Ammonia	Observed for color changes
Tannins	50% ethanol, Ferric chloride 2%	Black blue color

Health Benefits

Onion contains a strong chemical compound used for Health benefit, its use as a valuable medicine for treating the disease as well as consuming daily in our life as a dietary consumption. Onion has a different medicinal property for treating different diseases. Now recently we used as a traditionally and pharmacologically [9].

(A). Traditional usage

Allium cepa has been used from ancient times and the management of various ailments. There used mentioned in Ayurveda, Siddha, Unani. It was used as a vegetable or spice and medicine in the 6th century in India [42]. It regularly used in the low growing country or developing countries and now it is used as a traditionally used in several disorders [43, 44]. It is widely used for the following treatment;

1. Cold and cough
2. Hernia
3. Trauma debility
4. Blood purifier healing
5. Scurvy
6. Metabolic disorders
7. Skin disease
8. Insect bite
9. Pneumonia
10. Urinary system disorder
11. Hey fever
12. Ear disorder
13. Sexual
14. Wound
15. Toothache

(B). Pharmacological usage: [8, 45]

1. Antioxidants
2. Antifertility
3. Anticarcinogenic
4. Analgesic effect
5. Antiplatelet disease
6. Anti-inflammatory
7. Anti-hypertensive
8. Diuretic
9. Antihelminthic
10. hypolipidemic
11. Anti-diabetic
12. Immunoprotective
13. Cardiovascular
14. Antibiotic

Pharmacological Effect	MOA	References
Antioxidants	Free radical scavenging, chelation of transition metal ions, and inhibition of oxidases such as lipoxygenase.	[46, 47]
Anticarcinogenic	Inhibition of mutagenesis and modulation of enzyme and cell signaling pathway	[45, 48]
Analgesic	selectively relieve pain by acting in the CNS and peripheral pain mediators	[49]
Antiplatelet	Inhibited thromboxane A2 synthesis activity	[50]
Anti-inflammatory	Inhibition of inflammatory cell influx	[49, 51]
Anti-hypertensive	Prevent from angiotensin-second induced endothelial dysfunction	[52]
Anti-viral	Destroying the synthesis of viral protein and nucleic acid	[53, 54]
Fibrinolytic	Increase fibrinolysis	[55]
Hypolipidemic	Reduction in both serum cholesterol and triglyceride level	[56, 57, 58, 59]
Anti-diabetic	Increase pancreatic β cell, Increase insulin secretion	[60, 61]
Hepatoprotective	Decrease the deposition of fats in the liver cell. Heme oxygenase 1 triggers the function of quercetin against induced Hepatotoxicity.	[62, 63]
Immunosuppressant effect	Inhibition Immuneresponse	[64, 65, 66]
Cardiovascular disease	Inhibiting platelet aggregation, Decrease in serum thromboxane (TXB2)	[67, 68]
Antibiotic	Inhibit the protein synthesis of fungi and bacteria	[69, 70]

Some of *Allium cepa* pharmacological properties as under

1) Antioxidants

The latest research has shown the potent antioxidant properties of the *allium cepa*. In the research, scientists evaluated the reducing capacity of *allium cepa* and it also showing free- radical scavenging capacity [71]**.** *Allium cepa* containing phenolic compounds that shown antioxidant and immunostimulating and its demonstrated protection of DNA damage caused by free radicals [72]. Flavonols have the main role in antioxidant quercetin and quercetin glucosides is the main compound show significant antioxidant [73]. The antioxidant activity was analyzed by four method DPPH, ABTS radical scavenging, FRAP reducing power, and (ORAC) oxygen radical absorbance capacity assay [72]. Total phenolic content expresses antioxidant properties. The purpose of this study was to investigate activity the scavenging of hydrogen peroxide and the reducing capacity of fair types of onion extract [70, 74]. *Allium cepa* were allied with antioxidant activity in male Wistar rats against streptozotocin (STZ) [75]. The homogenate fresh onion and hot water extract of fresh aerial parts of *Allium cepa* exhibit significant inhibition of lipid peroxidation [76]. Onion consumption has been associated with a reduced risk of neurodegenerative disorder [77].

2) Antidiabetic

Allium cepa significantly reduced the peak only. Flavonoid shows antidiabetic property it increases insulin secretion, [78, 79] Quercetin's main role in type 2 diabetes and it accelerated the secretion of insulin and increase the uptake of calcium ions from separated pancreatic cells [80, 81, 82]. It also demonstrated the potent diabetic effect of active compounds (Kaempferol and its various glycoside) of *allium cepa* [83]. A study of the alloxan-induced diabetic animal model has been shown that the antidiabetic effect of sulfur compound (S-methyl cysteine) and flavonoid (Quercetin) compound of *allium cepa* was comparable to the glibenclamide and insulin [84]. Clinical study has domestred the hyperglycemic effect of *allium cepa* on healthy volunteers [85]. experimental study is carried out the hypoglycemic effect of onion in alloxan-induced diabetic rats, glucose parameters have been estimated at various parameters (Plasma, Glucose, Urea, Creatinine, Total bilirubin) [86]. Diet appears to be an essential part of hyperglycaemic treatment. It does not only control the glucose concentration but also to reduce the several complications of hyperglycemic. *Allium cepa* was demonstrated a beneficial effect in STZ induce Diabetic rats [74].

3). Anti-hypertensive

Quercetin and its methylated metabolite isorhamnetin, found in onion can decrease blood pressure and put off angiotensin-II induced endothelial dysfunction by inhibiting the overexpression of p4phox, a narrow subunit of the membrane NADPH oxidase, The subsequent increased superoxide production resulted in a high nitric oxide bioavailability [87]. A study showed the effect of onion on blood pressure (NO) Nitro-L-arginine methyl ester) induced hypertensive rats [88].

4). Anti-allergic

Quercetin is the great chemical constituent of *allium cepa*. *Allium cepa* extract of Quercetin shown the anti-allergic Immune response characterized by and stimulus of the immune system, anti-viral activity, Inhibition of histamine release, decrease pro-inflammatory cytokines [89, 90], leukotrienes creation and suppresses interleukins IL-4 production and it can progress the contain antigen-specific IgE antibody formation [12].

5).Anti-inflammatory activities;-

It is a process of complex biological activity, Several animals model have been studied to the role of flavonoid against inflammation as well as quercetin and kaempferol have an anti-inflammatory property [91]. *Allium cepa* exhibits potent anti-inflammatory effect showing in experiment Sprague –

Dawley rats. Anti-inflammatory activity of *allium cepa* extract was carried out by using the carrageenan-induced rat paw edema method. Its extract using against the diclofenac sodium [49]. Quercetin has an anti-inflammatory effect on prostaglandin leukotrienes, Histamin release activity had been investigated [92]. Thiosulfinates and cepaens in onion have been shown to possess anti-inflammatory properties [93]. The action is related to inhibition of inflammatory cell influx bythiosulfinates and cepaenes. Some studies demonstrated *in vitro* that quercetin has a role in the inhibition of different isotypes of immunoglobulins such as IgM, IgG, and IgA all are mitogen stimulate [94].

6). Anticancer activity

Phytochemical of onion role in preventing various carcinogenic activities, many Flavonoid and phenolic compound role to reduce the risk of cancer and it has potential cancer, chemopreventive agents [95, 96]. Onion reduced the different cancer risk in humans, through a different mechanism to prevent cancer, including inhibition of tyrosin kinase, including cell cycle arrest, regulation of P53 protein, Heat shock protein inhibition and blocking the expression of Ras protein [97]. Quercetin is the best compound for treating cancer it shows tyrosine kinase inhibition in the human phase first trial [98]. Kaempferol is also used as an anticancer agent in different cancer and pancreatic, breast, lung, leukemic, ovarian cancer [99]. *Allium cepa* has shown anticancer property through several mechanisms (1) cytotoxic and antiproliferative effects on (MCF-7, MDA-MB231, HC-60, HepF2, HT29, and PC3 cells). (2) Immunomodulation (increase NK activity increase macrophage phagocytosis). (3) anti-inflammatory (decrease COX expression, decrease 25 phosphate). (4) antioxidant (ROS scavenging, Induction of apoptosis, Antigenotoxicity, blocking the signaling pathway, and other antitumor effect show). [48] it has several chemical (polyphenolic and organosulphur compound) demonstrated an anticancer effect on MCF-7 cells [100].

7). Antiplatelet

Allium cepa peel extract has anti-platelet effects in rat platelets. Its inhibited platelet aggregation via inhibition of aggregation inducing molecule intrecellular calcium channel and TXA2 by blocking COX-1 and TXAS activity in dose depending manner [50]. The antiplatelet effect was comparatively studied for all the fractions using rat PRP. It shows a different effect in different concentrations [72]. Flavonols have the main role in antioxidant quercetin and quercetin glucosides is the main compound show significant platelet aggregation [71]. Some study demonstrated the antiplatelet actions shows inhibition thromboxane A2 synthase inhibition and TXA2/PGH2 receptor blockade and shown antiplatelet actions in Sprague-Dawley rats [101, 102]. *Allium cepa* is used as sources of Anti-platelet agents that may contribute to the prevention of CVS disease. Sulfinate and flavonols have the main role in illustrating anti-platelet property [103, 104].

8). Hepatoprotective activity

Allium cpea has shown Protective from liver damage. Quercetin has shown a protective effect against iron is because hepatic injury in mice liver cell [105]. Anthocyanins also show hepatoprotective because anthocyanin (Cyanidin-3-0-β-glucoside promote Hepatic expression Gclc expression after than increase the level of cAMP level and phosphorylation of binding for better transcription of Gclc protein [106].

9). Antiviral activity

Some study demonstrated the flavonoids have been very effective against the virus, flavonoid shows antiviral activity. Flavonoid inhibiting viral growth lies in blocking and destroying the synthesis of viral protein and nucleic acid [107, 108]. Quercetin as well as kaempferol has shown virucidal activity against different viruses (Herpes simplex type 1 virus, Rabies virus, Poliovirus, Mengovirus, Pseudorabies virus, parainfluenza type 3 virus) Quercetin Flavonol may inhibit the replication of different respiratory, viruses reducing their viral count [109, 110].

Conclusion

Onion is second worldwide cultivated vegetables all over the world. It uses in our daily life as a vegetable for attractive the essence and taste of various varieties of foods as well as its used a salad form ancient time. Which contains many important phytoconstituent that are useful for our health. Secondary metabolite acquires different biological properties. Which possess pharmacological activities such as include antioxidants, antifertility, anticarcinogenic, analgesic, antiplatelet, anti-inflammatory, anti-hypertensive, diuretic, fibrinolytic, antihelminthic, hypolipidemic properties, anti-diabetic, immunoprotective effect, and cardiovascular disease. It containing several biological potencies such as antibiotic effect. The above review shows that phytoconstituent and pharmacological activities can protect Human beings against various diseases we can add onion in daily lifestyle.

Reference

1. Pareek S, Sagar NA, Sharma S, Kumar V. *Onion* (*Allium cepa* L.). Fruit and Vegetable Phytochemicals. 2017 May;58(2):1145-61.
2. Khare CP. Indian Medicinal Plants- An illustrated dictionary. Springer publications, 2002.
3. Jarald Edwin E, Jarald Edwin Sheeja. Pharmacognosy and Phytochemistry. 2009;81-293-1488-1.
4. Ashwini M, Sathishkumar R. Onion (*Allium cepa*)-Ethnomedicinal and therapeutic properties. Research Signpost. 2014;37(2):27-34.
5. Selvaraj S. Onion queen of the kitchen. Kisan World. 1976;3(12):32-34.
6. Marrelli M, Amodeo V, Statti G, Conforti F. Biological properties and bioactive components of *allium cepa* L. Focus on potential benefits in the treatment of obesity and related comorbidities. Molecules, 2019, 24(1).
7. Kumar KP, Sampath Bhowmik, Debjit, Chiranjib, Biswajit, Tiwari Pankaj. *Allium cepa*: A traditional medicinal herb and its health benefits. Journal of chemical and pharmaceutical Research. 2010;2(1):283-291.
8. Bora K, Sharma A. Phytoconstituents and therapeutic potential of *allium cepa* linn. A Review. Pharmacognosy Reviews. 2009;3(5):170-180.
9. Teshika JD, Zakariyyah AM, Zaynab T, Zengin G, Rengasamy KR, Pandian SK, *et al*. Traditional and modern uses of onion bulb (*Allium cepa* L.): a systematic review. Critical Reviews in Food Science and Nutrition. 2019;59:S39-S70.
10. Rhodes MJC, Price KR. Analytical problems in the study of flavonoid compounds in onions. Food Chem. 1996;57:113-117.

11. Bilyk A, Cooper PL, Sapers GM. Varietal differences in distribution of quercetin and kaempferol in onion (*Allium cepa* L.) tissues. J Agri Food Chem. 1984;32:274-276.
12. Mlcek J, Jurikova T, Skrovankova S, Sochor J. Quercetin and its anti-allergic immune response. Molecules, 2016;21(5):1-15.
13. Breu, W. *Allium cepa* L. (Onion) Part 1: Chemistry and analysis. Phytomedicine. 1996;3(3):293-306.
14. Hirota S, Shimoda T, Takahama U. Tissue and spatial distribution of flavonol and peroxidase in onion bulbs and stability of flavonol glucosides during the boiling of the scales. J Agri Food Chem. 1998;46:3497-3502.
15. Panisset B, Tissut M. Physiol. Veg. 1983;21(1):49.
16. Tungmunnithum D, Thongboonyou A, Pholboon A, Yangsabai A. Flavonoids and Other Phenolic Compounds from Medicinal Plants for Pharmaceutical and Medical Aspects: An Overview. Medicines. 2018;5(3):93.
17. Astuya A. Pharmacological activities of flavonoids: A review. Aquaculture Research. 2017;48(7):9006-9014.
18. Rhodes MJC, Price KR. Analytical problems in the study of flavonoid compounds in onions. Food Chemistry. 1996;57(1):113-117.
19. Nöthlings U, Murphy SP, Wilkens LR, Henderson BE, Kolonel LN. Flavonols and pancreatic cancer risk: the multi ethnic cohort study. Am J Epidemiol. 2007;166(8):924-931.
20. Sood AR, Josh IKK. Indian Chem. Soc. 1974;51(11):975.
21. Williams CA, Grayer RJ. Anthocyanins and other flavonoids. Nat Prod Res. 2004;21(4):539-573.
22. Miguel MG. Anthocyanins: Antioxidant and/or anti-inflammatory activities. Journal of Applied Pharmaceutical Science. 2011;1(6):7-15.
23. Patel K, Jain A, Patel DK. Medicinal significance, pharmacological activities, and analytical aspects of Anthocyanidins 'Delphinidin': A concise report. Journal of Acute Disease. 2013;2(3):169-178.
24. Itoh T, Tamura T, Mitsuha shi T, Matsumoto T. Phytochemistry. 1977;16:140.
25. Sallam LAR, El-Refai AH, Edrees M, Abdel-Fatt ah AE. Qual. Plant. 1974;24:159.
26. Ruhl 1, Herrmann KZ. Leb ensm. Unters. Forsch. 1985;180:2-15.
27. Ramawat KG, Mérillon JM. Plant Steroidal Saponins: Natural products: Phytochemistry, botany and metabolism of alkaloids, phenolics and terpenes. Natural Products: Phytochemistry, Botany and Metabolism of Alkaloids, Phenolics and Terpenes, 2013, 1-4242.
28. Yuan L, Ji TF, Li CJ, Wang AG, Yang JB, Su YL. Two new steroidal saponins from the seeds of *allium cepa* L. Journal of Asian Natural Products Research. 2009;11(3):213-218.
29. Mayank Thakur1, Matthias F, Melzig2 Hendrik, Fuchs1 Alexander Weng1. Chemistry and pharmacology of saponins: special focus on cytotoxic properties; Botanics: Targets and Therapy. 2011;1:19-29.
30. Augusti KT. Therapeutic values of onion and garlic. Ind J Exp Biol. 1996;34:634-640.
31. Breu W. *Allium cepa* L. (onion) part 1. Chemistry and analysis. Phytomed. 1996;3:293-306.
32. Putnik P, Gabrić D, Roohinejad S, Barba FJ, Granato D, Mallikarjunan K, *et al*. An overview of organosulfur compounds from Allium spp.: From processing and preservation to the evaluation of their bioavailability, antimicrobial, and anti-inflammatory properties. Food Chemistry. 2019, 2018 Jul;276:680-691.
33. Parcell S. Sulfur in human nutrition and applications in medicine. Alternative Medicine Review. 2002;7(1):22-44.
34. Meriel GJ, Jill H, Angela T, Jonothan M, Brian A, Hamish AC. Biosynthesis of the flavor precursors of onion and garlic. J Exp Botany. 2004;55:1903-1918.
35. Sharath Balakrishna, Asmita A. Gamma-glutamyl transferases: A structural, mechanistic and physiological perspective; Division of Biochemical Sciences, National Chemical Laboratory, 2014.
36. OJ O. Phytochemical and proximate analysis, mineral, and vitamin compositions of *Allium cepa* bulb extract. Advances in Biomedicine and Pharmacy. 2016;03(04):181-186.
37. Shenoy C, Patil MB, Kumar R, Patil S. Preliminary phytochemical investigation and wound healing activity of *Allium cepa* Linn (Liliaceae). International Journal of Pharmacy and Pharmaceutical Sciences. 2009;2(2):167-175.
38. Boukeria S, Kadi K, Kalleb R, Benbott A, Bendjedou D, Yahia A. Phytochemical and physicochemical characterization of *Allium sativum* L. and *Allium cepa* L. Essential oils. Journal of Materials and Environmental Science. (2016);7(7):2362-2368.
39. Verma M, Charan Singh C, Jeet Singh SS, Rose NM. Phytochemical screening of onion skin (*Allium cepa*) dye extract. ~ 1414 ~ Journal of Pharmacognosy and Phytochemistry. 2018;7(6):1414-1417.
40. AFMM. Phytochemical Screening and *in vitro* Activity of *Allium cepa*. L. Ethanol Extract Against Bacteria Isolated from Hawked Moringa oleifera Meal Sold within Kaduna Metropolis. Nigerian Journal of Chemical Research. 2017;22(2):82-87.
41. Fossen T, Pedersen AT, Andersen ØM. Flavonoids from red onion (*Allium cepa*). Phytochemistry. 1998;47(2):281-285.
42. Kabrah A. The Antibacterial Activity of Onion on MSSA and MRSA Isolates of Staphylococcus aureus. Biomedical Sciences. 2010;1:24-64.
43. Jaradat NA, Ayesh OI, Anderson C. Ethnopharmacological survey about medicinal plants utilized by herbalists and traditional practitioner healers for treatments of diarrhea in the West Bank/Palestine. Journal of ethnopharmacology. 2016;182:57-66.
44. Silambarasan R, Ayyanar M. An ethnobotanical study of medicinal plants in the Palamalai region of Eastern Ghats. India. Journal of Ethnopharmacology. 2015;172:162-178.
45. Griffiths G, Trueman L, Crowther T, Thomas B, Smith B. Onions - A global benefit to health. Phytotherapy Research. 2002;16(7):603-615.
46. Suzuki Y, Masashi I, Segami TMI. Antiulcer effects of antioxidant, quercetin, a-tocopherol, nifedipine, and tetracycline in rats. Jpn J Pharmacol. 1998;78:435-441.
47. De Groot H, Rauen U. Tissue injury by reactive oxygen species and the protective effects of flavonoids. Fundam Clin Pharmacol. 1998;12:249-255.
48. Asemani Y, Zamani N, Bayat M, Amirghofran Z. Allium vegetables for possible future of cancer treatment. Phytotherapy Research. 2019;33(12):3019-3039.
49. KNK KB, Evaluation of Ethanolic Root Extract of *Allium cepa*. L.For Analgesic and Anti-Inflammatory Activities in Animal Models. World journal of current medical and pharmaceutical research. 2019;2(1):67-73. 2582-0222.

50. Ro JY, Ryu JH, Park HJ, Cho HJ. Onion (*Allium cepa* L.) peel extract has anti-platelet effects in rat platelets. Springer Plus. 2015, 4(1).
51. Dorsch W, Schneider E, Bayer T, Breu W, Wagner H. Antiinflammatory effects of onions: inhibition of chemotaxis of human polymorphonuclear leukocytes by thiosulfinates and cepaenes. Int Arch Aller Appl Immunol. 1990;92:39-42.
52. Sanchez M, Lodi F, Vera R. Quercetin and isorhamnetin prevent endothelial dysfunction, super oxide production, and overexpression of p47(phox) induced by angiotensin II in rat aorta. J Nutr. 2007;137:910-915.
53. ZandiK, Teoh BT, Sam SS, Wong PF, Mustafa MR, Abu Bakar S. Antiviral activity off our types of bioflavonoid against dengue virus type-2.Virol J. 2011;8:560.
54. Vrijsen R, Everaert L, Boeyé A. Antiviral activity of flavones and potentiation by ascorbate. J Gen Virol. 1988;69:1749-1751.
55. Agarwal RK, Dewar HA, Newell DJ, Das B. Controlled trial of the effect of cycloalliin on the fibrinolytic activity of venous blood. Atherosclerosis. 1977;27:347-351.
56. Lata S, Saxena KK, Bhasin V, Saxena RS, Kumar A, Srivastava NK. Beneficial effects Alliums Sativa, Alliums cape, and Commiphora Mukul on experimental hyperlipidemia and atherosclerosis: A comparative evaluation. J Postgra Medic. 1991;37:132-135.
57. Sainani GS, Desai DB, Saine P. Onion in the prevention of atherosclerosis. J Ind Medical Associ. 1978;71:109.
58. Knekt P, Kumpulainen J, Järvinen R. Flavonoidin take and risk of chronic diseases. Am J Clin Nutr. 20027;6(3):560-568.
59. Gebhardt R, Bech H, Wagner KG. Inhibition of cholesterol biosynthesis by allicin and ajoene in rat hepatocytes and HepG2 cells. Biochim Biophys Acta. 1994;1213:57-62.
60. Kobori M, Masumoto S, Akimoto Y, Takahashi Y. Dietary quercetin alleviates diabetic symptoms and reduces streptozotocin-induced disturbance of hepatic gene expression in mice. Mol Nutr Food Res. 2009;53(7):859-868.
61. Vessal M, Hemmati M, Vasei M. Antidiabetic effects of quercetinin streptozotocin induced diabetic rats. Comp Biochem Physiol CT oxicol Pharmacol. 2003;135(3):357-364.
62. Zhang Y, Li H, Zhao Y, Gao Z. Dietary supplementation of baicalin and quercetin attenuate esironoverloadin ducedm ouseliver injury. Eur J Pharmacol. 2006;535(1):263-269.
63. Lekic N, Canova NK, Horinek A, Farghali H. The involvement of heme oxygenase 1 but not nitric oxide synthase 2 in a hepatoprotective action of quercetin in lipopolysaccharide-induced hepatotoxicity of Dgalactosamine sensitized rats. Fitoterapia. 2013;87:20-26.
64. Chisty M, Quddus R, Islam B, Khan B. Effect of onion extract on immune response in rabbits. Bangladesh Med Res. Counc Bull. 1996;22:81-85.
65. Steerenberg PA, Garssen J, Dortant P, Hollman PC, Alink GM, Dekker M. Protection of UV-induced suppression of skin contact hypersensitivity: A common feature of flavonoids after oral administration. Photochem Photobiol. 1998;67:456-461.
66. Shoskes DA. Effect of bioflavonoids quercetin and curcumin onischemic renal injury. Transplan. 1998;66:147-152.
67. Causey JL, Feirtag JM, Gallaher DD, Tungland BC, slavin JL. effect of dietary inulin on serum lipids, blood glucose and the gastrointestinal environment in Hypercholesteralemic men., Nutr Res.(2000);20: 191-201
68. Moon CH, Jung YS, Kim MH, Lee SH, Baik EJ, Park SW. Mechanism of antiplatelet effect of onion: araechidonic acid release inhibition, thromboxane A (2) synthase inhibition and TXA (2) /PGH(2) receptor blockade., Prost Leukot Essent Fatty acids. 2000;62:277-283.
69. Phy N, Higashiyama T, Tsuji M. An antifungal compound from roots of Welsh onion, Phytochemistry. 1999;52;271-274.
70. Cammue BPA, Thevissen K, Hendriks M. A potent antimicrobial protein from onion seeds showing sequence Homology to plant lipid transfer proteins, plant physiol. 1995;109:445-455.
71. Benkeblia N. Free-radical scavenging capacity and antioxidant properties of some selected Onions (*Allium cepa* L.) and garlic (*Allium sativum* L.) extracts. Brazilian Archives of Biology and Technology. 2005;48(5):753-759.
72. Lisanti A, Formica V, Ianni F, Albertini B, Marinozzi M, Sardella R, *et al*. Antioxidant activity of phenolic extracts from different cultivars of Italian onion (*Allium cepa*) and relative human immune cell proliferative induction. Pharmaceutical Biology. 2016;54(5):799-806.
73. Ko EY, Nile SH, Jung YS, Keum YS. Antioxidant and antiplatelet potential of different methanol fractions and flavonols extracted from onion (*Allium cepa* L.). 3 Biotech, 2018, 8(3).
74. Campos KE, Diniz YS, Cataneo AC, Faine LA, Alves MJQF, *et al*. Hypoglycaemic and antioxidant effects of onion, *Allium cepa*: Dietary onion addition, antioxidant activity and hypoglycaemic effects on diabetic rats. International Journal of Food Sciences and Nutrition. 2003;54(3):241-246.
75. Prakash D, Singh BN, Upadhyay G. Antioxidant and free radical scavenging activities of phenols from onion (*Allium cepa*). Food Chemistry. 2007;102(4):1389-1393.
76. Hughes B, Lawson L. Antimicrobial effects of *Allium sativum* L. (garlic), *Allium ampeloprasum* L. (elephant garlic), and *Allium cepa* L. (onion), garlic compounds and commercial garlic supplement products. Phytother Res. 1991;5:154-158.
77. Shutenko Z, Henry Y, Pinard E, Seylaz J, Potier P, Berthet F. Influence of the antioxidant quercetin *in vivo* on the level of nitric oxide determined by electron paramagnetic resonance in rat brain during global ischemia and reperfusion. Biochem Pharmacol. 1999;57:199-208.
78. Roman-Romos R, Flores-Saenz JL, Alaricon_Aguilar FJ. Antihyperglycemic effect of some edible plants. Journal of Ethnopharmacology. 1995;48(95):25-32.
79. Vessal M, Hemmati M, Vasei M. Anti diabetic effects of quercetin in streptozotocin induced diabetic rats. Comp Biochem Physiol C Toxicol Pharmacol, 2003;135(3):357-364.
80. Knekt P, Kumpulainen J, Järvinen R, Flavonoid intake and risk of chronic diseases. Am J Clin Nutr. 2002;76(3):560-568.
81. Hii CST, Howell SL. Effects of flavonoid son insulin secretion and 45 Ca^{2+} handling intra tablets of Langerhans. J Endocrinol. 1985;107(1):1-8.

82. Hii CS, Howell SL. Effects of epicatechin on rat islets of Langerhans. Diabetes. 1984;33(3):291-296.
83. Ikechukwu JO, Ifeanyi O. The Antidiabetic Effects of The Bioactive Flavonoid (Kaempferol-3-O-D-6{P-Coumaroyl} Glucopyranoside) Isolated from *Allium cepa*. Recent Patents on Anti-Infective Drug Discovery. 2016;11(1):44-52.
84. Akash MSH, Rehman K, Chen S. Spice plant *Allium cepa*: Dietary supplement for treatment of type 2 diabetes mellitus. Nutrition. 2014;30(10):1128-1137.
85. Jain RC, Vyas CR. Letter, hypoglycemia action of onion on rabbits. Br Med J. 1974;2:730.
86. El-Demerdash FM, Yousef MI, El-Naga NI. A. Biochemical study on the hypoglycemic effects of onion and garlic in alloxan-induced diabetic rats. Food and Chemical Toxicology. 2005;43(1):57-63.
87. Sanchez M, Lodi F, Vera R. Quercetin and isorhamnetin prevent endothelial dysfunction, super oxide production, and over expression of p47(phox)induced by angiotensinII in rat aorta. J Nutr. 2007;137:910-915.
88. Sakai Y, Murakami T, Yamamoto Y. Antihypertensive effects of onion on no synthase inhibitor-induced hypertensive rats and spontaneously hypertensive rats. Bioscience, Biotechnology and Biochemistry. 2003;67(6):1305-1311.
89. Kimata M, Shichijo M, Miura T, Serizawa I, Inagaki N, Nagai H. Effects of luteolin, quercetin and baicalein on immunoglobulin E-mediated mediator release from human cultured mast cells. Clin. Exp. Allergy. 2000;30:501-508.
90. Marzocchella L, Fantini M, Benvenuto M, Masuelli L, Tresoldi I, Modesti A, *et al*. Dietary flavonoids: Molecular mechanisms of action as anti-inflammatory agents. Rec. Patents Inflamm. Allergy Drug Disc. 2011;5:200-220.
91. Jachak SM. Natural products: potential source of COX inhibitors. CRIPS. 2001;2(1):12-15.
92. Weissenberger H. Isolation and identification of the platelet aggregation inhibitor present in onion (*Allium cepa*). FEBS Lett. 1972;26:105-108.
93. Dorsch W, Schneider E, Bayer T, Breu W, Wagner H. Antiinflammatory effects of onions: inhibition of chemotaxis of human polymorphonuclear leukocytes by thiosulfinates and cepaenes. Int Arch Aller Appl Immunol. 1990;92:39-42.
94. Cumella JC, Faden H, Middleton E. Selective activity of plant flavonoids on neutrophil Chemiluminescence (CL). J Allergy Clin Immunol. 1987;79(1):157-157.
95. Appelt LC, Reicks MM. Soy induces phase IIenzymes but does not inhibit dimethylbenz [*a*] anthracene induced carcinogenesis in female rats. J Nutr. 1999;129(10):1820-1826.
96. Kamaraj S, Ramakrishnan G, Anandakumar P, Jagan S, Devaki T. Anti oxidant and anti cancer efficacy of hesperidinin benzo [*a*] pyrene induced lung carcinogenesis in mice. Invest New Drugs. 2009;27(3):214-22.
97. Duthie GG, Duthie SJ, Kyle JA. Plant polyphenolsin cancer and heart disease: implications as nutritional antioxidants. Nutr Res Rev. 2000;13(1):7. 9-106.
98. Ferry DR, Smith A, Malkhandi J. Phase I clinical trial of the flavonoid quercetin: pharmacokinetics and evidence for *invivo* tyrosine kinase inhibition. Clin Cancer Res. 1996;2(4):659-668.
99. Chen SS, Michael A, Butler MA, Nuel SA. Advances in the treatment of ovarian cancer: A potential role of anti-inflammatory phyto chemicals. Discov Med. 2012;13(68):7-17.
100. Zamri N, Hamid HA. 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 for Human Nutrition. 2019;74(4):525-530.
101. Moon CH, Jung YS, Kim MH, Lee SH, Baik EJ, Park SW. Mechanism for antiplatelet effect of onion: AA release inhibition, thromboxane A2 synthase inhibition and TXA2/PGH2 receptor blockade. Prostaglandins Leukotrienes and Essential Fatty Acids. 2000;62(5):277-283.
102. Moncada S, Vane JR. Pharmacology and endogenous roles of prostaglandin endoperoxides, thromboxane A2, and prostacyclin. Pharmacol Rev. 1979;30:293-331.
103. Makheja AN, Bailey JN. Antiplatelet constituents of garlic andonion. Agents Actions. 1990;29:360-363.
104. Cavagnaro PF, Camadro A, Galmarini CR, Simon PW. Effect of cooking on garlic (*Allium sativum* L.) antiplatelet activity and thiosulfinates content. J Agric. Food Chem. 2007;55:1280-1288.
105. Zhang Y, Li H, Zhao Y, Gao Z. Dietary supplementation of baicalin and quercetin a ttenuat esironoverload induced mouse liver injury. Eur J Pharmacol. 2006;535(1):263-269.
106. Zhu W, Jia Q, Wang Y, Zhang Y, Xia M. Theanthocyanincyanidin-3-*O*-β glucoside, a flavonoid, increases hepatic glutathione synthesis and protects hepatocytes against reactive oxygenspecies during hyperglycemia: in volvementofac AMP–PKA-dependent signaling pathway. Free Rad Bio Med. 2012;52(2):314-327.
107. Castrillo JL, Carrasco L. Actionof3-methylquercetin onpolio virus RNA replication. J Virol. 1987;61(10):3319-3321.
108. Zandi K, Teoh BT, Sam SS, Wong PF, Mustafa MR, Abu Bakar S. Antiviral activity off our types of bioflavonoid against dengue virus type. Virol J. 2011;2(8):560.
109. Kumar S, Pandey AK. Chemistry and biological activities of flavonoids: anover view. Sci World J. 2013. ID162750.
110. Calderon-Montaño JM, Burgos-Moron E, Perez-Guerrero C, Lopez Lazaro M. A review on the dietary flavonoid kaempferol. Med Chem. 2011;11(4):298-344.