



International Journal of Pharmacology

ISSN 1811-7775

science
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Asian Network for Scientific Information

Onion (*Allium cepa* L.): An Alternate Medicine For Pakistani Population

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Abstract: Various diseases are common in Pakistani population and major reason for their prevalence is the lack of modern health facilities. Current review was aimed to find the potential medicinal uses of *Allium cepa*, which is a culinary herb. A number of studies have proven its potential use against human pathogenic organisms. Its extract and powder was found to have inhibitory activity against tumor cells. Moreover scientifically proven hypoglycemic, cardioprotective and hypolipidemic activities suggest its potential use in diabetes and cardiovascular diseases. It is also useful to reduce the risk of bone injuries especially in females. Onion is a rich source of flavonoids, polyphenols, organic sulfur, saponins and many other secondary metabolites, which are mainly responsible for its medicinal activities. Its organic sulfur compounds, which contribute for its different medicinal potentials are sensitive towards cooking; moreover this sensitivity is also variety dependant which means it's more beneficial in its raw form. On the basis of reviewed literature it is concluded that it possesses significant beneficial health effects and its incorporation in daily food especially in raw form will provide protection against many diseases.

Key words: Anti-pathogenic, anticancer, hypolipidemic, cardioprotective, anti-diabetic, hepatoprotective, anti-depressant, osteoporotic, antioxidant, organosulfur

INTRODUCTION

Pakistan's population is suffering from various health issues like diabetes, high cholesterol, heart diseases, obesity, depression, diarrhea and anemia (Basit and Shera, 2008; Hakeem and Shaikh, 2002; Jafar *et al.*, 2008; Pappas *et al.*, 2001; Shera *et al.*, 2010). In rural areas men are more commonly suffering from obesity, dyslipidemia and metabolic syndrome (Zahid *et al.*, 2008a). Type 2 diabetes with depression cause high morbidity and mortality in Pakistan (Perveen *et al.*, 2010). Shera *et al.* (2007) reported the prevalence of diabetes in urban and rural areas of Pakistan. They reported that 6.0 and 6.9% men and 3.5 and 2.5% women are suffering from diabetes in urban and rural areas, respectively. In another study Zahid *et al.* (2008b) reported that rural population of Pakistan is majorly suffering from type 2 diabetes and Impaired Fasting plasma Glucose (IFG). In a study totally focusing on urban areas of Karachi Dodani *et al.* (2004) reported that 38.5% of studied people were suffering from hypertension, 10.7% from high cholesterol and 9.1% from diabetes while 52.2% people were found to be obese. In Balochistan, people are suffering from esophageal cancer, diabetic retinopathy, crimean-congo hemorrhagic fever, obesity and other diseases (Smego *et al.*, 2004;

Roohullah *et al.*, 2005; Mushtaq *et al.*, 2009; Qayyum *et al.*, 2010).

The main reason why people are suffering from these health issues is the lack of well structured health care system (Akram and Khan, 2007). Due to unequal distribution of income in Pakistani population its major portion has limited access to modern health facilities (Yasmeen *et al.*, 2011). In comparison to modern medicines traditional medicines serve as a cheap source of medication for poor people. This could be the reason that "More than 70% of the developing world's population still depends primarily on the complementary and alternative systems of medicine" (Azaizeh *et al.*, 2008). Shaikh *et al.* (2009) reported the increased use of traditional medicines in Pakistan's population. Mostly herbs are employed to treat skin problems, diabetes, respiratory diseases and many other local ailments (Abbasi *et al.*, 2010; Ahmad *et al.*, 2009; Shinwari *et al.*, 2009; Ishtiaq *et al.*, 2007; Malik *et al.*, 2011). Onion (*A. cepa* L.) is a biennial medicinal herb and belongs to the family Alliaceae (Zubair *et al.*, 2009). It is an old cultivated plant with edible bulb and has been reported for its antimicrobial, antitumor, hypolipidemic, dermatological activities (Akerreta *et al.*, 2007; Ali *et al.*, 2000; Sarwar *et al.*, 2011). In Pakistan onion is mainly used as

condiment and is an essential part of daily cooking (in raw and cooked form). Many studies aiming to increase its production highlights its importance in agricultural system (Abdelrazzag, 2002; Ahmad and Khan, 2000; Islam *et al.*, 2002; Malik *et al.*, 2003; Malik *et al.*, 2004; Syed *et al.*, 2000; Tarafder *et al.*, 2003; Yucel and Duman, 2005). The aim of current mini-review is to find out the potential remedial uses of onion with reference to health related issues of Pakistan.

THERAPEUTIC USES OF ONION (*A. CEPA*)

Since long, onion has been used as a traditional medicine either alone or in combination with other medicinal herbs against various diseases (Novaretti and Lemordant, 1986; Saeed *et al.*, 2004). Here is a brief look on potential medicinal uses of onion with scientifically proven studies.

Anti-pathogenic activity: Bacteria and fungi are the main cause of different infectious diseases in humans. In a Stanford medical station during heart transplantation 43.6, 41.7 and 10.2% of total infections were found to be caused by bacteria, viruses and fungi, respectively (Montoya *et al.*, 2001). The Aqueous Extracts of Onion (AOE) showed dose dependent protective effect against pathogenic yeast and dermatophytes (Shams-Ghahfarokhi *et al.*, 2006). AOE inhibit the growth of *Trichophyton rubrum* and *T. mentagrophytes* by affecting their morphology at cellular and sub cellular level as it disrupts the cell membranes and other membrane bounded structures (Ghahfarokhi *et al.*, 2004). These two species have been isolated from patients suffering from various skin diseases (El-Said, 2001). In different studies onion showed protective effect against pathogenic bacteria (*Escherichia coli*, *Pseudomonas* sp.), fungi (*Candida*, *Cryptococcus* and *Malassezia* spp.) in dose dependant manner (Razzagh *et al.*, 2008; Irkin and Arslan, 2010). This antimicrobial activity of onion is also variety dependant as few varieties like green onion have least preventive effect against microbes. Benkeblia (2004) reported that its essential oil possess significant antimicrobial activity. The ethyl acetate subfractions of onion showed the prevention against microbes which may be due to the presence of flavonoids in these extracts (Santas *et al.*, 2010). In another study it was found that onion inhibits the pro-inflammatory messengers and bacterial growth due to the presence of various organic sulfur compounds (Wilson and Adams, 2007). In nutshell onion possesses significant inhibitory activity against human related pathogens.

Anticancer activity: The population of Pakistan is suffering from many cancer problems like esophageal, cervical, gallbladder, breast and ovarian cancer (Badar *et al.*, 2005; Bhurgri, 2004; Imam *et al.*, 2008; Liede *et al.*, 2002; Malik, 2003). Tumor or cancer is linked with obesity, nutrient deficit food, concentrated sugars, low fiber intake etc., which may be prevented by the use of *Allium* sp. (Donaldson, 2004). Herman-Antosiewicz and Singh (2004) reviewed the literature and concluded that organosulfur compounds derived from *Allium* sp. are responsible for their anticarcinogenic properties. Izzo *et al.* (2004) concluded that consumption of both garlic and onion may have anticarcinogenic effects on health. In another study, Shrivastava and Ganesh (2010) identified that onion has better inhibitory activity against tumor cells than garlic. Nitric oxide scavenging might be the reason for its anticarcinogenic activity as identified by Lee *et al.* (2009). Recently El-Aasr *et al.* (2010) isolated a new sulfur containing compound from onion, they found that this compound have potential to inhibit the growth of tumor cells. Asim *et al.* (2011) reported that 24% of leukaemia patients die during therapy (85% due to infection after therapy and 10.8% due to haemorrhage). In a study conducted by Fu (2004) it was reported that hot air dried onion powder can strongly inhibit the leukemia cell growth. He also stated that onion could be used in powder form for medicinal purposes. The onion powder obtained from hot, vacuum and freeze-dried onion showed the ability to scavenge the free radical and inhibit the growth of Leukemia cells. All of the above reports suggest that use of onion may have significant role in dealing with cancer related health issues.

Hypolipidemic activity: Hyper-cholesterol was found to have positive link with obesity and heart problems (Dennis *et al.*, 2006). Onion extracts have shown hypolipidemic activity, as reported by Vidyavati *et al.* (2010) that dehydrated onion feed causes decrease in the low-density lipoprotein of hypercholesterolemic rat's serum. This feed also caused increase in blood concentration of glutathione, ascorbic acid and α -tocopherol (Vitamin E), which is reported to have significant activity against lipid metabolism disorders of diabetes (Tabatabaei *et al.*, 2008). Emmanuel and James (2011) also noted the same results in rat serum. According to them the increased concentrations of onion extracts lowered the total cholesterol, triacylglycerol and low density lipoprotein cholesterol but increased the high density lipoprotein cholesterol. Onion possesses cholesterol lowering activity and it might be incorporated in daily food to lower the serum cholesterol levels.

Cardioprotective activity: In a study conducted at Aga Khan University Hospital (Pakistan) it was found that young (<45 years) males are majorly suffering from heart disease called acute myocardial infarction (Saleheen and Frossard, 2004). Total 976 patients were studied; 16.1% of these patients were young (<45 years) and out of which 93.1% were male. For heart disease onion is better to use in raw or moderately cooked form. Pungency has a positive correlation with antiaggregatory activity of onion which prevents the cardiovascular disease and overheating significantly decreases both of these activities (Cavagnaro *et al.*, 2007). This decrease in pungency and antiaggregatory activity was due to the instability of sulfur compounds against heating. Ischemic heart injury (an important heart disease caused by reduced blood supply) and hypoxia-induced cell death can also be treated with methanolic extracts of onion (Park *et al.*, 2009). These extracts inhibit the Reactive Oxygen Species (ROS), cytochrome c release and depolarization of mitochondrial membrane which ultimately prevents the cell death of heart tissues. The comparative study between Korean Lotus Roots (KLR) and Polish White Onion (PWO) showed that phenolic, tannin, anthocyanin, flavin etc. contents of PWO are highly unstable against overheating (Makris and Rossiter, 2001; Im *et al.*, 2011). The extended boiling time (10, 20, 40 and 60 min) of onion decreases the concentration of these compounds. In another study Gorinstein *et al.* (2008) found that these compounds (phenols, anthocyanins, tannins etc.) of red onion are stable against blanching, boiling, frying and microwave heating. These studies indicate that stability of these compounds to heat is variety dependent. Gorinstein *et al.* (2009) found 100% methanol an efficient extractor of these compounds than 50% methanol and 100% acetone. So, methanol extracts of onion varieties having heat stable phytochemicals may be used alone or in combination with other treatments to deal with heart related disorders.

Anti-diabetic activity: Diabetes is due to high level of sugars in blood and it is estimated that in 2030 4.4% of world population will suffer with this disease (Wild *et al.*, 2004). Diabetes mellitus is affecting most of humans today by affecting their biochemical activities; medicinal herbs are found to be very useful against this disease (Gupta *et al.*, 2008; Kokil *et al.*, 2010; Haque *et al.*, 2011). In an experiment on diabetic rats it was found that the onion juice can reduce the defects of liver and kidney caused by alloxan-induced diabetes in rats (El-Demerdash *et al.*, 2005). One mL/100 g of body weight onion dosage caused an increase in plasma glucose, urea, creatinine and bilirubin of these rats. High blood glucose

levels were noted short after the intake of sweetened food, which initiates the oxidative stress and consequently causes oxidative stress-linked diabetes. To control this postprandial blood glucose levels Kim *et al.* (2011) perform an experiment on rats fed with sucrose. They observed that ethylene extracts of onion (containing quercetin) significantly controls the blood glucose levels by inhibiting the activity of α -glucosidase (involved in the absorption of glucose in intestine). The daily use of onion may have preventive effect against many glucose related disorders.

Onion as an inhibitor of bone fractions: Osteoporotic fractions in humans occur due to the resorption of bones; consumption of onion can increase the bone mass with resorption inhibition (Muhlbauer *et al.*, 2002). In an experiment conducted by Wetli *et al.* (2005) the effect of onion as anti-resorption of bones was confirmed. This resorption causes the osteoporosis of bones by the tartrate-resistant acid phosphatase positive multinucleated cells. According to their findings γ -Glutamyl Peptide extracted from onion showed the inhibition of bone resorption. To prevent the osteoporosis nutrition keeps an important value. Tang *et al.* (2009) performed an experiment on rats to examine the effects of onion diet on ovariectomy-induced bone resorption of rats. They found that water solution of onion crude cause the inhibition of osteoclastogenesis receptor activator by the ERK, p38 and NF- κ B pathways. In a separate study Tsuji *et al.* (2009) observed the effect of quercetin in bone resorption prevention in Ovariectomized (OVX) female mice. They found that quercetin inhibits the bone loss without affecting the uterus of OVX. It has been reported that male's bone (trabecular) has more strength than females (Mohsen, 2006). In another study, Matheson *et al.* (2009) found that regular onion consumption has significant positive effects against perimenopausal and postmenopausal non-Hispanic in 50 years and older white women. Moreover, 20% less risk of hip fracture was recorded in women who frequently consume onion than non consumers. Regular use of onion may be helpful in reduction of bone related medical issues especially in women.

Hepatoprotective activity: Arsenic found in Pakistan's water cause liver cancer (Wadhwa *et al.*, 2011). According to Ige *et al.* (2009) sever exposure to heavy metal Cd (Cadmium) can cause the liver defects but onion can check these defects because of its anti-oxidant activity. They found that Cd cause the decrease in urine volume, Plasma and tissue Superoxide Dismutase activity (SOD), renal clearance etc., pretreatment with onion prevented

the liver from these defects. Obioha *et al.* (2009) also stated that Cd causes liver toxicities by increasing the lipid peroxidation and glutathione S-transferase levels and by decreasing the glutathione-superoxide dismutase levels. In their experiment they observed that high dosages of onion extracts can prevent Cd-induced oxidative damages to rat's liver. Vidyavati *et al.* (2010) found increased Vitamin E levels in rat's serum as a result of onion administration; this vitamin is reported to have beneficial effect on renal oxidative damage in rats (Adaramoye, 2009). Son *et al.* (2008) found that fermented onion juice having higher amount of quercetin aglycone prevents the hepatic damage of oxidative agents. The use of onion in daily diet can reduce the occurrence of liver diseases so it should be adopted in routine life.

Anti-depressant activity: Onion also acts as antidepressant; Jaouad (2010) found that higher concentration of oxidative species cause the anxiety and depression which can be reduced by the use of onion. The polyphenols present in onion might be protecting the brain from depression and anxiety. In another study, Sakakibara *et al.* (2008) found that quercetin might be responsible for its antidepressant activity in mouse. So, as a whole onion may act as a useful antidepressant agent.

Other therapeutic uses of onion: A high level of serum uric acid not only directly damages the kidneys but is also a risk factor for other diseases like cardiovascular and diabetes (Dehghan *et al.*, 2008; Feig *et al.*, 2008). Haidari *et al.* (2008) found that serum uric acid levels significantly lowered on administration of onion to artificially induced hyperuricemic rats. A sulfur containing

compound (derived from *A. cepa*) showed decreased memory impairments and hippocampus lipid hydroperoxide in senescence-accelerated mouse (Nishimura *et al.*, 2006). The outer layers of red onion (*A. cepa*) showed the high antioxidant activity and had the capacity to scavenge the free radicals. In another study, the inner layers of red and violet varieties of onion showed the ability to remove heavy metals from body (Prakash *et al.*, 2007) which shows potential use of onion to treat toxicity caused by heavy metals. Singh *et al.* (2009) reported that the peels of red onion had the excellent antioxidant and antimutagenic ability which was due to its high concentration of polyphenolic compounds. The flavonoids (quercetin and kaempferol) present in onion increases the enzymatic activity of microphages by enhancing the expression of High-Density Lipoprotein (HDL) receptors (Duh *et al.*, 2008). Onion prevents the muscle contraction e.g., saponins from onion bulbs potentially had antispasmodic activity and thus prevent the disturbance to gastrointestinal tract (Corea *et al.*, 2005).

CONCLUSION

Pakistan's population is suffering from many diseases like diabetes, hypercholesterol, depression, liver and bones problems, mainly due to the lack of health facilities. Therefore there is a need of less costly nutritive alternative medicine such as onion (a natural cheap food) which has a number of therapeutic effects as shown in Table 1. It possesses a variety of organic sulfur compounds, like flavonoids, organosulfur compounds, polyphenols, quercetin, S-alk(en)yl-L-cysteines and

Table 1: Therapeutic effects of onion

Activity against disease	Used form	Active compounds	Reference
Anti-pathogenic (antifungal, antibacterial)	Aqueous extract, Essential oil, Ethyl acetate subfractions	Flavonoids, Organosulfur compounds	Benkeblia (2004), Ghahfarokhi <i>et al.</i> (2004), Shams-Ghahfarokhi <i>et al.</i> (2006), Razzagh <i>et al.</i> (2008), Wilson and Adams (2007), Irkin and Arslan (2010), and Santas <i>et al.</i> (2010)
Anticancer	Bulb, Dried powder	Organosulfur compounds	Herman-Antosiewicz and Singh (2004), Fu (2004) and El-Aasr <i>et al.</i> (2010)
Hypolipidemic	Aqueous Extract	n/a	Vidyavati <i>et al.</i> (2010), Emmanuel and James (2011)
Cardioprotective	Raw form, Moderately cooked form, Methanolic extracts	n/a	Cavagnaro <i>et al.</i> (2007), Gorinstein <i>et al.</i> (2009) and Park <i>et al.</i> (2009)
Antidiabetic	Aqueous extract, Ethylene extract	Quercetin	El-Demerdash <i>et al.</i> (2005) and Kim <i>et al.</i> (2011)
Bone fractions	Aqueous extract	γ -Glutamyl peptide	Wetli <i>et al.</i> (2005), Matheson <i>et al.</i> (2009), and Tang <i>et al.</i> (2009)
Hepatoprotective	Aqueous extract	Quercetin aglycone	Ige <i>et al.</i> (2009), Obioha <i>et al.</i> (2009), and Vidyavati <i>et al.</i> (2010)
Anti-depressant	n/a	Quercetin, Polyphenols	Sakakibara <i>et al.</i> (2008), Jaouad (2010)
Renoprotective	Aqueous extract	n/a	Haidari <i>et al.</i> (2008)
Memory impairments	n/a	S-alk(en)yl-L-cysteines	Nishimura <i>et al.</i> (2006)
Antioxidant	Methanolic extract	Polyphenols	Prakash <i>et al.</i> (2007), Singh <i>et al.</i> (2009)

n/a: Not available

γ -Glutamyl peptide. All of these compounds are responsible for its significant activity against various health issues like, inflammation, cancer, heart diseases, diabetes, kidney problems and infectious diseases. Some of the compounds present in it are heat sensitive, so in order to get maximum benefit it should be consumed in raw or semi-cooked form. In most of the studies its aqueous extract is found to have significant beneficial effects. Incorporation of its aqueous extract in daily routine life will have beneficial effects on human life, especially for the common man of Pakistan, as being a cheaper alternative medicine.

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