Folk Medicine, Pharmacological and Biological Activities

Besides making a significant nutritional contribution to human diet, onions also have medicinal and functional properties (Lanzotti, 2006). It has been used as a medicinal agent for thousands of years. Its tuber is used as tonic, aphrodisiac, stimulant, diuretic, antidiabetic, expectorant, emmenagogue, carminative, antispasmodic, anthelmintic, stomachic, anti-infective agent, against tumours, vomiting, pain and bleeding piles. Externally, it has been used as a rubefacient and poultice, giving relief in skin diseases and insect bites. Also, it increases fibrinolysis and lower blood pressure (Kirtikar and Basu, 1984; Al-Bekairi *et al*., 1991; Saleheen *et al*., 2004). Jacob and Anwar (2009) reviewed the range of garlic- and onion-derived substances capable of preventing the formation of cancer cells, preventing cancer cell proliferation, and killing cancer cells (e.g., by induction of apoptosis).

Onion extract is effective *in vitro* against many bacteria species including *Bacillus subtilis, Salmonella typhimurium* and *Escherichia coli* (Cavallito and Bailey, 1944; Didry *et al*, 1992; Yoshida *et al.*, 1998; Yin and Cheng, 2002; Benkeblia, 2004; Benkeblia and Lanzotti, 2007; Chaithradhyuthi *et al*, 2009). Some of the quercetin oxidation products, isolated from yellow onion showed antibacterial activity. The two compounds 2-(3,4-dihydroxyphenyl)-4,6-dihydroxy-2-methoxybenzofuran-3-one and 3-(quercetin-8-yl)-2,3-epoxyflavanone presented selective activity against *Helicobacter pylori* strains (Ramos *et al*., 2006). The antibiotic action of tsibulins, onion phytoalexins, on some fungi, Gram-positive and Gram-negative bacteria was studied in vitro. Tsibulins were more toxic against Gram-positive bacteria than against Gram-negative bacteria. Tsibulins had a high fungitoxic activity. The antibacterial effect of onion phytoalexins was associated with their ability to inhibit DNA and RNA synthesis in bacterial cells (Dmitriev *et al*., 1989b).

The antifungal activity of onion extracts and/or its constituents has been reported. Singh

and Deshmukh (1984) stated that the volatiles from *Allium cepa* showed an excellent inhibition of spore germination in some of the tested fungi. The extract of onion showed fungicidal effect on two important dermatophytes, *Trichophyton rubrum* and *Trichophton mentagrophytes*, at concentrations > 3.12% v/v (Shams-Ghahfarokhi *et al*., 2004). Benkeblia (2004) investigated the effect of five different concentrations of essential oil extracts of three types of onion and garlic against three fungi, *Aspergillus niger, Penicillium cyclopium* and *Fusarium oxysporum*. Although *Fusarium oxysporum* was less inhibited, the other two fungi were significantly inhibited. Similarly, Shams-Ghahfarokhi *et al*. (2006) also studied the antifungal activity of aqueous extracts prepared from onion and garlic against *Malassezia furfur, Candida albicans* and other *Candida* species. These authors noted that all onion and garlic inhibited growth of all fungi tested and the inhibition was dose-dependent. The most observed inhibitory dose of onion was 2 mg/ml, while for garlic this dose ranged from 65 to 125 µg/ml (Benkeblia and Lanzotti, 2007). Allicepin, a peptide isolated from onion, exerted an inhibitory activity on mycelia growth in several fungi species including *Botrytis cinerea, Fusarium oxysporum, Mycosphaerella arachidicola* and *Physalospora pericola* (Wang and Ng, 2004).

The aqueous extract of onion was found to possess antileishmanial activity. Concentration of 1.25 mg/ml was found to be leishmanial for all the *Leishmanial* strains tested (*Leishmanial major, Leishmanial tropica, Leishmanial infantum, Leishmanial mex mex* and *Leishmanial donovani*), whereas 50% of all parasites of all strains were found to be dead at an average value of 0.376 mg/ml after 72 hours treatment (Saleheen *et al*., 2004).

The antioxidant activity of onion or its constituents has been reported (Štajner *et al*., 1998b; Nuutila *et al*., 2003; Chaithradhyuthi *et al*., 2009). Evaluation of antioxidant activity against DPPH for the quercetin oxidation products (isolated from yellow onion) showed that the four products and 2,5,7,3',4'-pentahydroxy-3,4-flavandione are more active than quercetin (Ramos *et al*., 2006). The flavonoids, alluceposide, quercetin, quercetin 3'-*O*-glucoside and quercetin 7,3'-*O*-diglucoside (isolated from the bulbs of red onion) posess a significant antioxidant activity (Zaghloul, 2007). The uptake in the human body of quercetin glycosides (antioxidants) from onion has been reported to be relatively high in comparison to other quercetin sources like apple and tea (Mogren *et al*., 2006b). The antioxidant activity of *S*-methyl cysteine sulphoxide, isolated from *Allium cepa* has been reported by Kumari and Augusti (2002). The highest antioxidant capacity was observed for red onion, followed by yellow, white and gerlot onion (Zill-E-Huma *et al*., 2011).

A total extract of dried Egyptian onion had a potent and a prolonged hypoglycemic effect on artificially induced diabetes in rats and rabbits (Galal and Gawad, 1965). The antidiabetic effect of *Allium cepa* has been reported by several authors (e.g. Gupta and Gupta, 1976; Dineshkumar *et al*., 2010; Ozougwu, 2011). It has been concluded that *Allium cepa* exhibited promising hypoglycemic and hypolipidemic activity in alloxan-induced diabetic rats. Both effects could represent a protective mechanism against the development of hyperglycemia and hyperlipidemia characteristic of *diabetes mellitus* (Ozougwu, 2011). Antidiabetic and antioxidant effects of *S*-methyl cysteine sulphoxide (SMCS) isolated from *Allium cepa* have been also reported (Kumari and Augusti, 2002).

Onion and its extracts have been shown to decrease blood lipid levels and the hypocholesterolemic effect of onion on humans has been reported. Bhushan *et al*. (1977) found that when healthy people were given raw onion in the diet (80 g daily for 5 months), the serum cholesterol levels significantly decreased to below normal values. Baghurst *et al* (1977) first reported the effect of onions on platelet aggregation in people who had consumed a high fat diet. This observation was confirmed by others, showing that chloroform extracts of *Allium cepa* and *Allium sativum* inhibit platelet aggregation *in vitro* induced by ADP or by

arachidonic acid (Borda, 1978; Makheja *et al*., 1981). The ethanol extract of *Allium cepa*, also causes the same effect (Philips and Poyser, 1978). Alliin (*S*-allyl-L-cysteine sulphoxide) was found to inhibit platelet aggregation *in vitro* (Liakopoulou-Kyriakides *et al*, 1985). Of the synthesized alliin analogues, prepared by Liakopoulou-Kyriakides (1985), only *alliicin* has a strong inhibitory effect on platelet aggregation. Makheja and Bailey (1990) stated that the *in vivo* antiplatelets effects of ingesting onion and garlic are attritutable more to adenosine than to *alliicin* and paraffinic polysulphide constituents. The hypolipidemic activity of onion flavonoids was also reported (e.g. Khushbaktova *et al*., 1991; Dineshkumar *et al*., 2010; Roldán-Marin *et al*., 2010).

Other activities have been also reported. A chloroform extract from the alcohol extract had a bronchodilatory activity (antiasthmatic) (Handa *et al*, 1983). Kreitmair (1936) reported that onion contains a heart stimulant which increased pulse volume and frequence, systolic pressure and coronary flow. It also stimulates the intestinal smooth musculature and the uterus, promotes bile production and reduces blood pressure. Hypodermic injection of 2 ml pressed onion juice/kg weight of rabbits increased their dieresis from 13 to 26 m/day, urea excretion from 0.62 to 1.09 g/day and Cl^- from 0.06 to 0.15 g/day (Balansard, 1951). Toxicity studies on *Allium cepa* have been reported. Nordio (1952) stated that the myelotoxic anemia resulted from feeding onions. Excessive and prolonged use of onions, to animals caused a grave irreversible anemia. Ecbolic (oxytocic) properties of crude extract of *Allium cepa* bulbs were 2.9 = 0.003 I.U. of oxytocin (Saha and Kasinathan, 1961). Toxicity comparison of extracts from six terrestrial plants to larvae of *Balanus albicostatus* was examined by Lin and Lu (2008). They found that the toxicity activities of the four species *Melia azedarach* L. and *Azadrichta indica* (Meliaceae), *Thevetia peruviana* K. Schum. and *Nerium indicum* Mill (Apocynaceae) were higher than those of *Allium cepa* and *Allium sativum.*

Aqueous extract of onion, given to mice for three months at a dose of 100 mg/kg in drinking water revealed a significant increase in the weight of tests and epididymes of the treated animals. The sperm count was significantly higher supporting an aphrodisiac potential of *Allium cepa*. No body weight gain was observed and a reduction in the liver weight and a decrease in red blood cells level were noticed. This study showed that onion is devoid of genotoxicity and estrogenic or anti-estrogenic activity (Al-Bekairi *et al*., 1991). Onionin A (a sulphur compound isolated from onion) showed the potential to suppress tumor-cell proliferation by inhibiting the polarization of M2 alternatively activated macrophages (El-Aasr *et al*., 2010).