Discussion

DISCUSSION

Natural products with high medicinal values are gaining much importance in light of the serious side effects posed by drugs of chemical origin (Sreekanth *et al.*, 2007). There is substantial evidence that high intake of antioxidant-rich foods, especially fruits and vegetables are associated with reduced risk of cancers (Borek, 2005). According to Corzo-Martínez *et al.* (2007) the minimum daily intake required to reduce cancer risk remains to be determined. Onion and garlic intake can offer protection against cancer development, and the use of these as therapeutic agents seems to be very safe, since all adverse effects described, appear with excessive and prolonged consumption.

Plants have evolved a number of inducible defense mechanisms against various diseases. Thus the plant kingdom represents a treasure trove of structurally diverse bioactive molecules. Several valuable drugs came into use through the study of folk medicine (Liu, 2005). Numerous bioactive natural products have been isolated from number of plants and many plant-derived substances that are classified as polyphenols are becoming increasingly known for their various biological effects, particularly antioxidant activities (Parra Cid *et al.*, 2003).

Onions have received considerable attention for their healthful, functional benefits and have been valued for their medicinal qualities by many cultures around the globe. Significant phytochemicals of onions include the organosulfur compounds such as cepaenes and thiosulfinates (Dorsch and Wagner, 1991 and Goldman *et al.*, 1996). The large classes of flavonoids including quercetin, kaempferol (Dorant *et al.*,

1994) and pigments such as anthocyanins have been found in red onions (Fitzpatrick *et al.,* 1993). This has led many researchers to test whether the proposed medicinal attributes of onions are valid. Antimicrobial, antioxidant properties of *A.cepa* have been shown (Fitzpatrick *et al.,* 1993). However, efficacy of the differential extracts of the edible part of *A.cepa* for the management of risk factors in human health had only little attention. Therefore, the present study was designed to evaluate the efficacy of different extracts of *Allium cepa* varieties by scavenging primary phytochemical properties, free radical scavenging activity, antimicrobial and antihelminthic activity.

In the present investigation, the preliminary phytochemical screening of aqueous, ethanol, chloroform and petroleum ether extracts of *Allium cepa* varieties (Red, white and small onion) revealed the presence of steroids, triterpenoids, flavonoids, phenols, tannins, alkaloids, saponins, acid, carbohydrates, glycosides and proteins. However, among the different extracts of *A.cepa*, ethanolic extract of small onion was found to possess more phytochemical constituents when compared with other extracts suggesting that onion extracts have potential ethanolic soluble phytochemical constituents. In accordance with the present study, phytochemical analysis of the crude extracts of various plants indicated the presence of major phytocompounds including phenols, alkaloids, glycosides, flavonoids, tannins etc. (Liu, 2005). The therapeutic value of plant is attributed their active constituents, which are being investigated to serve as pharmacological tools to provide health wellness (Liu, 2005). In addition to this, Panduranga Murthy *et al.* (2011) reported the presence of primary and secondary metabolites such as carbohydrate, proteins,

alkaloids, phenolic compounds and saponins which are confirmed in the present investigation also, through preliminary phytochemical analysis.

Total phenolic content

Phenolics are ubiquitous secondary metabolites in plants and possess a wide range of therapeutic use such as antioxidant, antimutagenic, anticarcinogenic and also decrease cardiovascular complications apart from possessing free radical scavenging activities (Yen *et al.,* 1993). The scavenging ability of the phenolics is mainly due to the presence of its hydroxyl group. In the present study, ethanolic extract of *A.cepa* (Small onion) showed presence of phenolic rich constituents such as quercetin, kaempferol, ferrulic acid and protocatechuic acid. However, quercetin was found to be the highest (40.25%) followed by kaempferol (23.65%). These results are in good agreement with the recent reports in which, flavonoids are the main constituent in the ethyl acetate sub fraction. But this represents only a small percentage of total phenols present in the aqueous subfractions (Singh *et al.,* 2009). This is consistent with the low solubility of flavonols in water with quercetin and kaempferol being the most common flavonoids present in onion extracts (Nuutila *et al.,* 2002 and Lanzotti, 2006). In addition to this, it has been reported that the edible part of the yellow onion variety had higher total phenol and flavonoid content (Sellappan and Akoh 2002; Yang *et al.,* 2004 and Santas *et al.,* 2008). In the present study also, the ethanolic extract of the edible part of the small onion showed the highest phenolic rich constituents which are potential antioxidants.

Invitro antioxidants

DPPH radical scavenging activity

Free radicals are known to play a definite role in a wide variety of pathological manifestations. Antioxidants fight with free radicals and protect us from various diseases. They exert their action either by scavenging the reactive oxygen species or by protecting the antioxidant defense mechanisms (Umamaheswari and Chatterjee, 2008).

DPPH assay is a primary antioxidant activity test that determines the free radical scavenging activity of respective samples. Primary antioxidant involves a mechanism, whereby it inhibits the oxidation by combining with the free radicals or reacting with hydrogen peroxides (Othman *et al.,* 2011). DPPH is a kind of stable free radical and accepts an electron (or) hydrogen radical to become a stable diamagnetic molecule which is widely used to investigate radical scavenging activity (Blois, 1958). In the DPPH radical scavenging assay, antioxidants react with DPPH and exist naturally in deep violet colour to turn into a yellow coloured diphenyl-picryl hydrazine. The degree of discoloration indicates the radical-scavenging potential of the antioxidant. The DPPH radical scavenging activity of all the extracts of *A.cepa* varieties (aqueous, ethanolic, chloroform and petroleum ether) increased in a dose-dependent manner. The results obtained in this investigation reveal that all the extracts are free radical scavenger and able to react with the DPPH radical, which might be attributed to their electron donating ability. However, the ethanolic extract of small onion showed the highest radical scavenging activity compared to that of

other varieties of *A.cepa* and it can be positively correlated with the total phenolic content. In accordance with the present investigation, it is worth to recall the report of Nuutila *et al.* (2003) who reported 50% DPPH radical scavenging activity of the methanol extract of the yellow onion. Moreover, it has been reported that wild onion significantly increased the DPPH radical scavenging activity in a dose-dependent manner (Panduranga Murthy *et al.,* 2011).

Nitric oxide radical scavenging activity

Nitric oxide is a free radical, produced in mammalian cells involved in the regulation of various physiological processes. However, excess production of nitric oxide has been implicated in various inflammatory and degenerative diseases (Pacher *et al.,* 2007). It is a diffusible free radical which plays many roles as an effector molecule in diverse biological systems including neuronal messenger, vasodilatation, antimicrobial and antitumor activities (Miller *et al.,* 1993). Although, nitric oxide and superoxide radicals are involved in host defense, over production of these two radicals contributes to the pathogenesis of some inflammatory diseases (Guo X *et al.,* 1999). Moreover, in the pathological conditions, nitric oxide reacts with superoxide anion and form potentially cytotoxic molecules, peroxynitrite (Guo X *et al.,* 1999).

In vitro inhibition of nitric oxide radical is a measure of antioxidant activity of plant drugs. Scavenging of nitric oxide radical is based on the generation of nitric oxide from sodium nitroprusside in buffered saline, which reacts with oxygen to produce nitrite ions that can be measured by using Griess reagent (Marcocci *et al.,*

1994). All the extracts of *A.cepa* varieties decreased the amount of nitrite generated from the decomposition of sodium nitroprusside *in vitro*. This may be due to the antioxidant principles in the extracts which compete with oxygen to react with nitric oxide thereby inhibiting the generation of nitrite. However, the ethanolic extract of small onion showed highest scavenging effect in a dose-dependent manner when compared with other onion extracts as well as the standard. The finding of the present investigation suggests that different extract of *A.cepa* varieties substantially inhibited nitric oxide production. Finally, the result indicates that the extract might contain compounds which may be able to inhibit nitric oxide and offers scientific evidence for the use of the extracts in indigenous system for various diseases condition.

Super oxide radical scavenging activity

Super oxide is a well known free radical of all oxygen derived species (McCord and Fridovich, 1969). Therefore, it is the first intermediate in the sequential univalent reduction of oxygen that leads to the formation of hydrogen peroxide (Harris *et al*., 2001). Superoxide radical is unique in that it can lead to the formation of many other reactive species, including hydroxyl free radical, hydrogen peroxide and perhydroxyl radicals (Pryor, 1986). It is involved in many pathological conditions. It mediates inflammatory tissue injuries in ischaemia-reperfusion, arthritis, gout, gastric ulceration. Superoxide radical has a low reactivity and a low capacity to penetrate the lipidic membrane layer, but it can generate hydrogen peroxide and highly reactive hydroxyl radical, via Haber-Weiss reaction (Rathee *et al.*, 2006). It induces oxidative damage in lipids, proteins and DNA (Pietta, 2000).

Several phytochemical compounds were able to efficiently scavenge superoxide radicals (Valentao *et al.,* 2001). These compounds may react with the super oxide radical via one-electron transfer mechanism or by hydrogen abstraction mechanism to form the corresponding semiquinone (Wang *et al.*, 1996).

In the present study, all the *A.cepa* extracts exhibited superoxide radical scavenging activity in a concentration-dependent manner. However, the small onion's ethanolic extract showed strong superoxide radical scavenging activity and this scavenging activity of the extracts can be explained by its polyphenolic content recorded in the present investigation. Polyphenols in onion extracts, scavenged directly superoxide radical by the hydrogen-donating capacity of their phenolic groups. In support of these finding, it has been reported that quercetin had been found to reduce the level of peroxynitrate, an extremely powerful oxidant in the brain, by scavenging superoxide anions (Shutenko *et al.,* 1999). The concentration dependent ferrous ion chelating capacity of red and violet varieties of onion increased from outer to inner layers. The most probable reason for the variation of free radical scavenging activity might be due to variation in the quantities of quercetin in the various layers of different varieties of onion (Dhan Prakash *et al.,* 2007). These results were further supported by HPLC results of the specific phenolic composition which showed high amounts of quercetin in the outer layers of the red variety. The mechanisms of action of quercetin include free radical scavenging, chelation of transition metal ions and inhibition of oxidases (de Groot and Rauen, 1998; Suzuki, *et al.,* 1998 and Lean *et al.,* 1999).

Free radical-mediated DNA damage

The plant prevents the DNA damage in a concentration dependent manner. Oxidative DNA damage has been implicated to be involved in various degenerative diseases (Jenner, 2003). Hydroxyl radicals generated by the Fenton reaction are known to cause oxidatively-induced breaks in DNA strands to yield its open circular or relaxed forms. It has been observed that proteins, lipids and DNA are the major targets of oxidative injury (Ames 1989; Agarwal and Said, 2003 and Klaunig *et al.*, 2010). Of these, DNA damage may be of particular importance as its role has been recognized in a large number of genetic disorders including cancers (Cooke *et al.*, 2003). Therefore, in the present study, the effects of differential crude extracts of *A.cepa* varieties were assessed based on the inhibition of free radiacal-mediated DNA damage. In the present study, the concentration dependent (100–500 μg/ml) free radical scavenging effect of different extracts of *A.cepa* varieties prevented DNA damage.

However, the small onion's ethanolic extract exhibited the maximum effects when compared with that of the other varieties of *A.cepa* varieties. Dose-dependent decrease in the Fenton's reaction-mediated degradation of DNA by the presence of the bulb extracts of *A.cepa* varieties, suggest that these extracts have compounds which may fight against free radical-mediated degradation to de-oxyribose sugar moiety of DNA and the extracts with high phenolic content showed better protection when compared to the others, indicating that protection was directly proportional to

the concentration of phytochemicals as well as total phenolic constituents. It has been reported that quercetin effectively protect DNA strand scission from tertbutylhydroperoxide (Sestili *et al.,* 1998). Moreover, it has been reported that the methanolic extract of the outer layer of red onion containing phenol possess better protection when compared to the others, indicating that the protection is directly proportional to the concentration of total phenolic content (Sestili *et al.,* 1998). Therefore, in the small onion variety, presence of high quantities of quercetin may be responsible for better protection from DNA damage as shown in the present investigation.

It is inferred from the present findings that the edible portion's extract of red, white and small onion varieties, in particular the small onion to possess rich of phenolic content with promising antioxidant and free radical scavenging activities, the ability to provide protection against DNA damage caused by reactive oxygen species. This present study together with the reports of the previous works suggest the triple synergistic action of phenols in scavenging ROS, repairing DNA radicals and metal chelation (Zhao *et al.,* 2005).

Antibacterial activity

Infectious diseases are the world's leading cause of premature deaths, killing almost 50000 people every day. Morbidity and mortality due to diarrheoa continues to be high in many developing countries, especially among children. Infections due to a variety of bacterial etiologic agents, such as *Escherichia coli, Vibrio cholerae,*

Areomonas spp., Shigella spp., Salmonella spp., Pseudomonas spp., *Klebsiella spp*., *Campylobacter spp*. and *Staphylococcus aureus* are most common. Drug resistance to human pathogenic bacteria has been commonly reported from all over the world (Piddock and Wise, 1989; Singh *et al.,* 1992 and Mulligen *et al.,* 1993). With the continuous use of antibiotics, the microorganisms have become resistant. In addition to this problem, antibiotics are sometimes associated with adverse effects on host which include hypersensitivity, depletion of beneficial gut and mucosal microorganism, immunesuppression and allergic reactions (Lopez *et al.,* 2001). This has created immense clinical problems in the treatment of infectious diseases. Therefore, there is a need to develop alternative antimicrobial drugs for the treatment of infectious diseases and one such approach is to screen local medicinal plants for their possible antimicrobial properties. Plant materials remain an important resource to combat serious diseases in the world. According to the World Health Organization, 80% of the world's population is dependent on the traditional medicine and a major part of the traditional therapies involves the use of plant extracts or their active constituents (Singh and Watal, 2010).

In recent years, the search for understanding the mode of action of plants with known microbial properties has markedly increased to the extent of finding out new effective compounds including low-molecular weight compounds like peptides and proteins (De Lucca and Walsh, 1999 and Selitrennikoff, 2001). Among these, *Allium spp*. attracts particular attention as they contain sulfur-based pharmaceutically interesting compounds (Calvey *et al.,* 1998). The inhibitory effects of different

formulations prepared from onion on fungi, bacteria and viruses have been established in earlier years (Elnima *et al.,* 1983 and Zohri *et al.,* 1995). However, studies on the efficacy of the bulb of *A.cepa* varieties on microorganisms are largely unknown. Hence, the present study was undertaken to investigate the antimicrobial potentials of different extracts of *A.cepa* varieties on Gram positive bacteria such as *Staphylococcus aureus, Streptococcus pyogenes, Micrococcus luteus, Staphylococcus epidermidis, Streptococcus pneumonia, Bacillus subtilis* and *Bacillus cereus* and Gram negative bacteria such as *Streptococcus mutans, Escherichia coli, Salmonella typhi, Klebsiella pneumonia* and *Pseudomonas aeruginosa*.

Results of the present investigation on the antibacterial activity of *Allium* species revealed that all the extracts of the onion varieties to possess antibacterial activity. When tested with Gram positive bacteria, the aqueous extract of red and small onion varieties were found to have highest range of growth inhibition on S*taphylococcus epidermidis* and *Bacillus cereus*, whereas white onion had least growth inhibition on the growth of *Staphylococcus aureus* and *Streptococcus mutans.* Results observed from the ethanolic extract showed that white onion was more effective on *Streptococcus pneumonia, Salmonella typhi* and *Klebsiella pneumonia* while red onion was less effective on *Escherichia coli* and *Staphylococcus epidermidis.*

When Gram positive and negative bacteria were tested with chloroform extract of *A.cepa*, white onion showed widest zone of inhibition with *Bacillus subtilis* followed by *Pseudomonas aeruginosa* whereas red onion showed the least inhibition

with *Bacillus cereus* and *Escherichia coli*. Results on the efficacy of petroleum ether extract revealed that red onion showed highest zone of inhibition on *Staphylococcus epidermidis* and *Escherichia coli* while white onion showed least zone of inhibition to *Staphylococcus aureus* among Gram positive and negative bacteria.

The aqueous and ethanolic extracts of all the three varieties of *A.cepa* recorded the maximum growth inhibition on Gram negative bacteria when compared to Gram positive bacteria. Whereas, chloroform and petroleum ether extracts showed highest zone of inhibition on Gram positive bacteria. Therefore, the onion-induced growth inhibition on both Gram positive and negative bacteria may be attributed to the presence of flavonoids and polyphenols which have been reported to have broad spectrum of antibacterial activity (Hendrich, 2006). Polyphenols from plants have been reported to have antibacterial activity (Ani *et al.,* 2006). An *in vitro* study showed that the purple and yellow onion juice exhibited antibacterial activity against *V. cholera* (Hannan *et al.,* 2010).

The results of the present investigation is also comparable with the study conducted by Hannan *et al.* (2010), which revealed the inhibition by ethanolic extract of onion against *Pseudomonas aeruginosa* a Gram negative bacteria. Moreover, it has been reported by Melvin *et al.* (2009) that the onion bulbs contain numerous organic sulphur compounds including, Trans-S-(1-propenyl) cysteine sulfoxide, S-methyl-cysteine sulfoxide, spropylcycteine sulfoxides, cycloallicin, flavonoids and phenolic acids and sterols. Cholesterol, stigma sterol, β-sitosterol, saponins and sugars and volatile oil of sulphur in trace quantities are few other sulphur on Allium

varieties compounds. The presence of these compounds may explain the antimicrobial property of this plant (Melvin *et al.*, 2009).

Although onion contains sulphur compounds such as S-propenylcysteine sulfoxide (isoalliin), S-propylcysteine sulfoxide, S-methylcysteine sulfoxide and dipropyl disulfide (Ali *et al.*, 2000), its main bioactive compound would be the phenolic rather than the sulphur because onions contain abundant flavonoids, especially quercetin and kaempferol (Nuutila *et al.*, 2003 and Corzo-Martinez *et al.*, 2007). It is also known from other studies that the crude extracts of onion to possess potent antibacterial and antifungal properties (Elnima *et al.*, 1983 and Benkeblia, 2004). Phenolic compounds such as quercetin and kaempferol present in onion may contribute to this activity (Rauha *et al.*, 2000 and Griffiths *et al.*, 2002). Essential oil extract from onion had a marked antimicrobial activity against certain pathogens, including *Staphylococcus aureus, Salmonella Enteritidis, Aspergillus niger, Penicillium cyclopium, and Fusarium oxysporum* (Benkeblia, 2004). Therefore, it may be appropriate to report in the present study that the bulb extracts of onion varieties possess antibacterial activity. This may be because of the presence of phenolic rich components such as quercetin and kaempferol which were recorded in the present study.

Antifungal activity

Fungi, comprise one of the five major kingdoms of organisms characterized by a unique specialized chitinous cell wall (Deacon, 1997). The eukaryotic non-motile organisms afford a diverse range of clinical manifestations including allergy,

toxic reactions and infections in human (mycoses) and non human mammals (Deacon, 1997 and Ajello and Hay, 1998). In recent years, a remarkable increase in the incidence of different mycoses due to aggressive cancer chemotherapy, widespread use of broad spectrum antibiotics, increasing number of immunosuppressive diseases and highly effective immunosupressants for organ transplantation has been reported (Anaissie *et al.*, 2003). Because of huge similarities between fungal and mammalian cells, there is a limited selective target for designing new antifungal formulations (Georgopapadakou and Walsh, 1994 and Barrett, 2002). On the other hand, available drugs, especially polyenes and azoles, suffer from a number of limitations, which can cause some difficulties in their applications. In this regard, host toxicity, drug resistance, drug to drug interactions, fungistatic mode of actions, and limited routes of applications were found to be considered in the treatment with antifungal agents (Georgopapadakou and Walsh, 1996). There is thus an urgent need for new antifungals with new modes of action, broad fungicidal spectrum and fewer doses-limited side effects (Graybill, 1996 and Maertens and Boogaerts; 2000).

It has been reported that onion exerts a marked antifungal activity against both yeasts and mycelia fungi including dermatophytes (De Lucca and Walsh, 1999 and Barrett, 2002). To investigate, how different extracts of *A.cepa* varieties act toward the important fungi, *Aspergillus niger, Aspergillus fumigates, Candida albicans and Aspergillus flavus* were selected for the present study. Results of the present investigation on antifungal activity reveal that the bulb of the onion varieties has

potential antifungal properties. The aqueous extract of red and small onions showed highest zone of inhibition with *Aspergillus niger* and *Aspergillus flavus* while white onion exerted least inhibition on *Candida albicans.* *I*n the ethanolic extract of white onion *Candida albicans* was most sensitive. However, red onion had least growth inhibition on the same fungi.

In the chloroform extract of white onion, *Aspergillus fumigates* was highly inhibited, whereas the red onion chloroform extract showed least inhibition on *Candida albicans.* When the petroleum ether extract of small onion was found to have widest zone of inhibition on *Candida albicans*, the petroleum ether extract of red onion showed least inhibition against *Aspergillus niger.* Finally, among the onion varieties analysed in the present investigation, the red onion exhibited strong fungal growth inhibition in its aqueous extract while small onion showed strong inhibition in its chloroform and petroleum ether extract whereas white onion is effective in its ethanolic extract. Regardless of antifungal activities of onion varieties, it has been shown that crude extracts of onion may also have potent antibacterial properties (Elnima *et al.,* 1983 and Benkeblia, 2004). Phenolic compounds such as quercetin and kaempferol present in onion may contribute to this activity (Rauha *et al.,* 2000 and Griffiths *et al.,* 2002). Onion-induced dose-dependent fungal growth inhibition observed in the present study may be attributed to the presence of phenols and secondary metabolites. In accordance to these findings, reports by Skerget *et al.* (2009) can be quoted here, which recorded the ethanol and acetone extracts of red

onion's skin and edible portion to possess antifungal activity against *A. niger, T. viride* and *P. cyclopyum.*

Moreover, it has been already reported that alliicin, thiosulfonates and other compounds of onion to exhibit fungistatic activities against *A. niger, Rhodotorula nigricans, Penicillium italicum, Penicillium cyclopium, Aspergillus flavus, Cladosporium macrocarpum, Aspergillus fumigatus, Aspergillus alutaceus, Aspergillus terreus* and *Penicillium chryogenum* (Wei *et al.,* 1967; Graham and Graham, 1986; Topal, 1989; Hafez and Said, 1997; Ankri and Mirelman, 1999 and Harris *et al.,* 2001). Finally, the differential antifungal activities of *A. cepa* varieties may be due to the presence of phenolic constituents recorded in the present study and it may also be due to the presence of other compounds such as allicin, thiosulfonates etc. (Wei *et al.,* 1967; Graham and Graham, 1986; Topal, 1989; Hafez and Said, 1997; Ankri and Mirelman, 1999 and Harris *et al.,* 2001).

Antihelminthic activity

Helminthiasis is one among the most important animal diseases inflicting heavy production losses. This disease is highly prevalent particularly in third world countries due to poor management practices (Rangari, 2004). Chemical control of helminthes coupled with improved management has been the important worm control strategy throughout the world. However, increasing problems in the development of resistance in helminths against antihelminthics have led to the proposal of screening medicinal plants for their anthelmintic activity. Phytomedicine has been used for a long period of time by farmers and traditional healers to treat parasitism and to

improve the performance of livestock. Many modern commercial medicines are derived from plants. However, scientific evidences for the anti-parasitic efficacy of these plant products are limited, regardless of their wide ethnoveterinary usage. Scientific validation of the anti-parasitic effects and possible side-effects of plant products in ruminants is necessary prior to their adoption as a novel method for parasite control (Githiori *et al.,* 2006). Although in many cases the active compounds in the herbal remedies have not been fully identified. Plant enzymes, such as cysteine and proteinases, or secondary metabolites, such as alkaloids, glycosides and tannins have shown dose-dependent anti-parasitic properties (Githiori *et al.*, 2006). A large number of gastro-intestinal trematode species (paramphistomes) have been described (Nofre sanchez, 2009). They can infect all ruminants but young calves and lambs are the most susceptible. Not all species of paramphistomes are pathogenic but clinical outbreaks of paramphistomiasis have been caused by *Cotylophoron cotylophorum (Asia), C. calicophorum, Paramphistomum microboth rium* (Africa), *P. ichikawar,* (Australasia) and *P. cervi* (Europe). One of the most frequent trematode responsible for this is *C. cotylophorum*. It affects domestic and wild ruminants, especially cows, sheeps, goats and buffalos in tropical and subtropical regions (Nofre sanchez, 2009). Therefore, the antihelminthic efficacy of *A.cepa* on *C.cotylophorum* is confirmed.

The results of the time and dose-dependent survival studies revealed that when the parasites were incubated in aqueous, ethanol, chloroform and petroleum ether onion extracts, the small onion extract was more effective in its antihelminthic

activity followed by the red and white onions suggesting that onion bulb extracts have potential antihelminthic effect.

Based on the available literature, the study on the antihelminthic activity of *A.cepa* varieties is first of its kind. In view of these findings, it can be reported that the bulbs of *Allium cepa* is a great source of active antihelminthic activity like the *Elletatria cardomomum* seeds of ethanolic extracts (Bidkar *et al.,* 2012). The onion-induced antihelminthic property may be due to the presence of active compound/s is in the secondary metabolites, i.e. plant products that have been associated with defensive mechanisms of plants against herbivore grazing (Mueller-Harvey, 1999 and Mueller-Harvey and Mcallan, 1992). Tannins were reported to form irreversible complexes with proline rich protein resulting in the inhibition of cell protein synthesis. Herbs that have tannins as their main components are astringent in nature and are used for treating intestinal disorders such as diarrhea and dysentery (Aiyegoro *et al.,* 2008). In the present study, presence of tannin in the onion extracts may also be responsible for their antihelminthic effect.

Based on the findings of the present investigation, it is concluded that the bulb of onion varieties have strong antihelminthic activity and it can be used as a traditional antihelminthic agent. However, further studies are essential to ascertain their active constituents to lay down recommendations.