THE EFFECTS OF SPROUTING ON THE ANTIOXIDANT POTENTIALS OF ONIONS (*Allium cepa* L.)

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Abstract: After sprouting of onions, the shoots are used as vegetables and bulbs discarded. These usually discarded onion bulbs may have improved antioxidant potentials resulting from sprouting. These improved properties could be harnessed to combat or manage some degenerative and non-communicable diseases. This study was therefore conducted to determine the effects of sprouting on the antioxidant potentials of onions (*Allium cepa* L.). Samples were sprouted for 0 – 10 days. Phytochemical (total phenols, flavonoids, ascorbic acid) analyses and antioxidant activities such as reducing power, DPPH and ABTS radicals scavenging activities were used to assess antioxidant potentials using standard methods.The results show that a significantly ($P<0.05$) higher total flavonoid content was expressed in methanol extract of onions sprouted for eight days (7.84 mg/g RE). Generally, sprouting for 2 – 8 days resulted in a significant ($P<0.05$) increase in all the antioxidant parameters tested. This was followed by a slight but significant decrease at the 10th day of sprouting. The present study shows that sprouted onions demonstrated higher antioxidant activity and can be considered as good sources of natural antioxidants.

Keywords: Onions, antioxidant, sprouting, methanol, chloroform, DPPH, ABTS

Introduction

Processing methods are known to have variable effects on total phenolic compound and antioxidant activity of plant samples. Effects include little or no change, significant losses, or enhancement in antioxidant activity (Nicoli *et al*., 1999). Food processing can improve the properties of naturally occurring antioxidants or induce the formation of new compounds with antioxidant activity, so that the overall antioxidant activity increases or remains unchanged (Tomaino *et al*., 2005).

Antioxidants present in vegetables are very useful and beneficial to health and have been associated with reduced risk of cardiovascular diseases and various forms of cancer (Kumud *et al*., 1990). These benefits have led to research studies in order to find antioxidants in plant material mainly used as foods (Yang *et al*., 2008). Among the compounds with antioxidant properties are the phenolics, which are believed to act as antioxidant, anti-carcinogenic, anti-microbial, anti-allergic, anti-mutagenic and anti-inflammatory, as well as in the reduction of cardiovascular diseases (Vali *et al*., 2007). Phenolics occur naturally in plants and are present in fruits, vegetables, leaves, nuts, seeds and flowers; therefore, they are present in the human diet, but are also used in some medicinal preparations (Madrau *et al*., 2008).

Onions *(Allium cepa* Linn) is used as foodstuff, condiments, flavouring agent, and in folk medicine (Ola-Mudathir and Maduagwu, 2014). It has been extensively studied for their therapeutic uses as antibiotic, antidiabetic, anti-atherogenic and anticancer (Augusti, 1996). It has been found that administration of onion products to diabetic rats significantly reduced hyperglycaemia (Kumud *et al*., 1990). Biological action of *Allium* products is ascribed to organosulfur compounds, which have also been shown to possess antioxidant and free radical scavenging activities. Onions have previously been shown to protect testis against cadmium induced oxidative stress in rats (Ola-Mudathir *et al*., 2008). Keeping this in mind, many studies have reported losses in total phenolic content and antioxidant activity of plant samples following thermal treatments. Losses were mainly reported in vegetables (Ismail *et al*., 2004; Roy *et al*., 2007; Toor and Savage, 2006). These losses in antioxidant property of heat-treated samples were attributed to thermal degradation of phenolic compounds (Larrauri *et al*., 1997) as well as other methods of food processing. However, there still remains paucity of information on the effect of different processing methods on the antioxidant status of onions which is essentially used in most kitchens for the preparation of delicacies as well as in the preparation of decoctions used by trado-medical practitioners for treatment of some ailments.

There is however a few reported studies on the effect of domestic processing on the antioxidant potentials of onions. Such information would be more relevant considering the fact that onions are rarely consumed raw without processing. Common processing methods include: remover of dry skin, chopping into smaller pieces before boiling, grilling or flying in oil. Several cultures also subject onions to sprouting for the purpose of using the shoots as vegetables. After sprouting, the onions bulbs are usually discarded while the shoots are processed further. These usually discarded onion bulbs may have improved antioxidant potentials resulting from sprouting. These improved properties could be harnessed to combat or manage some degenerative and non-communicable diseases.

This study is geared towards determining the effects of sprouting on the antioxidant potentials of onions (*Allium cepa* L.); with the following specific objectives:

- To determine the total phenolic content of different extracts of sprouted onions (aqueous, chloroform, and methanol).
- To determine the total flavonoids content of different extracts of sprouted onions.
- To determine the scavenging activity of DPPH radical of different sprouted onions extracts.
- To determine the reducing potential of sprouted onions (extract of methanol, chloroform and water).
- To determine the scavenging activity of ABTS radical of sprouted onions (extract of methanol, chloroform and water).
- To determine the Vitamin C content of onions as affected by sprouting (extract of methanol, chloroform and water).

Materials and Methods

Collection and preparation of sample

Sample of mature onions *(Allium cepa* L.) were obtained from a local Market in Esan West Local Government Area (Ekpoma) in Edo State. The dry skin of onions was removed and placed on stainless tray already over laid with wet tissue paper. They were allowed to sprout f or up to 10 days in the

dark at 25 – 30°C. Un-sprouted onion served as control. Subsequently 25 g of the raw and the processed samples were minced, grounded and extracted with different solvents (water, methanol and chloroform).

Methods

Method of extraction

About 25 g of the sprouted onions (0, 2, 4, 6, 8 and 10 days, respectively) were separately weighed using an analytical chemical balance into different beakers. They were homogenized separately using a laboratory mortar and pestle. The homogenized sample was then extracted with 100 ml of three different solvents: methanol, chloroform and water. The samples were centrifuged at 4000 rpm for 30 min. The supernatant was filtered through a filter paper (Whatman No. 1) into a beaker after which, it was concentrated and dissolved in dimethyl sulphoxide (DMSO).

Determination of total phenolic content (TPC) of Allium cepa extract

The concentration of phenolic compounds in the *Allium cepa* L. (sprouted) extracts were expressed as pyrocatechol equivalents (PEs) determined by Folin-Ciocalteu reagent according to the method of Slinkard and Singleton (1997) with minor modification. Briefly, 1 ml of the onion extract was measured into a volumetric flask and was filled with 46 ml of distilled aqueous. Briefly 1 ml of Folin-Ciocalteu reagent was added and mixed thoroughly. After 3 min, 3 ml of 2% anhydrous sodium carbonate (Na_2CO_3) was added and then allowed to stand for 2 h with intermittent shaking. The absorbance was measured at 760 nm in a spectrophotometer (JENWAY 6715, Bibby Scientific Ltd UK) against a blank consisting of all the reaction agents except the extracts.

The total concentration of phenolic compounds in the extract was determined as microgram of pyroctechol equivalent by using an equation that was obtained from standard pyrocatechol graph as:

$$\text{Absorbance} = 0.0021 \times \textit{total phenols} \; (\mu g \text{pyrocatechol}) - 0.0092 \; (R^2 = 0.9934)$$

Determination of total flavonoid content of Allium cepa L. extract

The total flavonoid was determined using the method of Meda *et al*. (2005). Briefly, 2 ml of 2% aluminium trichloride ($AlCl_3$) in methanol was mixed with the same volume of the extract solution. The mixture was incubated at room temperature for 10 min, and the absorbance was measured at 415 nm in spectrophotometer (JENWAY 6715, Bibby Scientific Ltd UK). Negative control, without extract was used as the blank. The total flavonoid content was determined as milligram of rutin equivalent by using an equation that was obtained from standard rutin graph as:

$$\text{Absorbance} = 0.0144 \times \text{total flavonoid (mg/g rutin)} + 0.0556$$

Determination of reducing power of Allium cepa L. extract

The reducing power of sprouted and boiled onions extract (sprouted for 0, 2, 4, 6, 8 and 10 days) was determined according to the method of Oyaizu (1986). Briefly 1 ml of the extract was mixed with 2.5 ml of phosphate buffer (0.2M, pH 6.6) and potassium ferricyanide ($K_3Fe(CN)_6$) (2.5 ml, 1%). The mixture was incubated at 50°C for 20 mins. Then, trichloroacetic acid (10%), 2.5 ml) was added to the mixture and centrifuged. Finally, the upper layer (2.5 ml) was mixed with distilled water (2.5 ml) and ferric chloride ($FeCl_3$) (0.5ml; 0.1%). The absorbance of the solution was measured at 700 nm in spectrophotometer (JENWAY 6715, Bibby Scientific Ltd UK). Blank was prepared with all the reagents without extract. Higher absorbance of the reaction mixture indicated that the reducing power is increased. Ascorbic acid was used as standards.

Determination of 1,1-diphenyl-2-picrylhydrazil (DPPH) radical scavenging activity by Allium cepa L. extract

The free radical scavenging activity of sprouted and boiled onions extract was determined using DPPH. The method used is similar to the method previously described by Gadow *et al*. (1997) with slight modification. In details, 2 ml of methanol solution of DPPH radical in concentration of 0.05 mg/ml and 1 ml of plant-extract were placed in cuvettes. The mixture was shaken vigorously and allowed to stand at room temperature for 30 min. Then the absorbance was measured at 517 mm against methanol as blank in spectrophotometer (JENWAY 6715, Bibby Scientific Ltd UK).

The DPPH radical concentration was calculated suing the following equation:

$$\text{DPPH Scavenging Effect (\%)} = \frac{A_o - A_1}{A_o} \times 100$$

Where A_0 is the absorbance of the negative control (2ml of methanol solution of DPPH radical + ml of 5% (DMSO) and A_1 is the absorbance of reaction mixture or standards. Ascorbic acid was used as the standard.

Determination of 2,2-azino-bis 3-ethylbenzothiazoline-6-sulfonic acid ($ABTS^+$) radical scavenging activity by Allium cepa L. extract

This was done by using the $ABTS^+$ free radical decolourization assay developed by Re *et al*. (1999) with some modification. Briefly, pre-formed radical monocation of ABTS was generated by reacting ABTS (7 mm) with 2.45 mm potassium per sulphate ($K_2S_2O_8$). The mixture was allowed to stand for 15 h (overnight) in the dark at room temperature. The solution was diluted with ethanol to obtain the absorbance of 0.6 ± 0.2 units at 750 mm. The plant extracts were separately dissolved in ethanol to yield a concentration of 1 mg/ml. An aliquot of 20 µl of ethanolic test solution of each sample was added to 180µl of ABTS free radical cation solution. The absorbance, monitored for 5 min was measured spectrophotometically at 750 nm (JENWAY 6715, Bibby Scientific Ltd UK). All measurements were performed in triplicate. Ascorbic acid was used as the standard.

Determination of ascorbic acid (vitamins C) on Allium cepa L. extract

The titrimetric method reported by Plummer (1978), was used for the determination of Vitamin C content. Briefly, 5 ml of diluted extract was measured into a boiling tube 1 ml of glacial acetic and was added. Then the mixture was titrated with 0.1 mg/ml 2, 6-dichlorophenolindophenol solution. A 5 ml solution of 0.022 mg/ml vitamin c solution was used as standard. Titre values of samples were compared with this value to obtain their vitamin c equivalent.

Statistical analysis

The results obtained were recorded as mean ± SEM (n=3). Significant difference was tested using Analysis of Variance (ANOVA) and Turkey Kramer Multiple Comparison Test. The Instat-GraphPad statistical software package was used for data analysis. The difference was considered statistically significant when $P<0.05$.

Results and Discussion

Total phenolic content of aqueous, methanol and chloroform extracts of onions sprouted for several days is presented in Table 1. In aqueous extract, it was observed that as sprouting days continued, the total phenolic content increased concomitantly until the eighth day (14.03 mg/g PE), after which further sprouting resulted in a significant reduction ($P<0.05$) in the total phenolic content. This was also similar in the methanol and chloroform extracts except that in methanol extract, total phenolic content of sprouted onions after 10 days (10.42 mg/g PE) was non-significantly lower than that

observed after four (4) days of sprouting. However, on a general note, a significantly higher ($P<0.05$) total phenolic content was noticed with eight (8) days of sprouting in all sample extracts determined (aqueous, methanol, and chloroform) compared to the control. The total flavonoid content of different extracts of onions that were sprouted for several days is shown in Table 2 above. Result shows that for aqueous and methanol extracts, sprouting causes a significant increase in flavonoid content of the onions when compared to the control. Therefore, a significantly ($P<0.05$) higher total flavonoid content was expressed in methanol extract of onions sprouted for eight days (7.84 mg/g RE). However, in aqueous and chloroform extracts, the total flavonoid content noticed after eight days of sprouting was non-significantly ($P>0.05$) lower than that observed after 6 days.

Table 1: Total phenolic content (mg/g PE) of differently sprouted onions

Extracts	Days of Sprouting					
	Control (Day 0)	Day 2	Day 4	Day 6	Day 8	Day 10
Aqueous	$4.84^{a} \pm 0.08$	$6.60^{b} \pm 0.06$	$10.42^{c} \pm 0.25$	$13.33^{d} \pm 0.07$	$14.03^{e} \pm 0.02$	$9.53^{f} \pm 0.02$
Methanol	$5.20^{a} \pm 0.05$	$6.84^{b} \pm 0.08$	$10.85^{c} \pm 0.06$	$14.02^{d} \pm 0.29$	$15.58^{e} \pm 0.03$	$10.42^{c} \pm 0.19$
Chloroform	$3.13^{a} \pm 0.02$	$4.84^{b} \pm 0.10$	$8.08^{c} \pm 0.05$	$11.51^{d} \pm 0.04$	$12.40^{e} \pm 0.06$	$8.83^{f} \pm 0.03$

Data are presented as mean ± standard error mean (SEM) of triplicate determinations; mean values with different alphabetical superscript within the same row suggests a statistically significant difference ($P<0.05$). PE = pyrocatechol equivalent.

Table 2: Total Flavonoid Content (mg/g RE) of Differently Sprouted Onions

Extracts	Days of Sprouting					
	Control (Day0)	Day 2	Day 4	Day 6	Day 8	Day 10
Aqueous	$4.06^{a} \pm 0.01$	$4.87^{b} \pm 0.03$	$5.19^{c} \pm 0.01$	$6.12^{d} \pm 0.00$	$6.71^{e} \pm 0.02$	$4.95^{b} \pm 0.02$
Methanol	$4.96^{a} \pm 0.02$	$5.64^{b} \pm 0.03$	$6.87^{c} \pm 0.01$	$7.79^{d} \pm 0.02$	$7.84^{d} \pm 0.02$	$5.15^{e} \pm 0.07$
Chloroform	$3.71^{a} \pm 0.02$	$3.44^{b} \pm 0.02$	$4.54^{c} \pm 0.01$	$5.73^{d} \pm 0.01$	$5.73^{d} \pm 0.01$	$3.12^{e} \pm 0.01$

Data are presented as mean ± standard error mean (SEM) of triplicate determinations; mean values with different alphabetical superscript within the same row suggests a statistically significant difference ($P<0.05$). RE = rutin equivalent.

Table 3: Reducing power (mg/AAE) of differently sprouted onions

Extracts	Days of Sprouting					
	Control (Day 0)	Day 2	Day 4	Day 6	Day 8	Day 10
Aqueous	$6.65^{a} \pm 0.05$	$7.09^{b} \pm 0.04$	$9.26^{c} \pm 0.05$	$13.92^{d} \pm 0.06$	$6.59^{a} \pm 0.06$	$6.15^{e} \pm 0.02$
Methanol	$9.31^{a} \pm 0.06$	$18.16^{b} \pm 0.03$	$22.12^{c} \pm 0.05$	$22.12^{c} \pm 0.05$	$8.43^{a} \pm 0.02$	$7.65^{d} \pm 0.03$
Chloroform	$4.54^{a} \pm 0.04$	$9.30^{b} \pm 0.04$	$17.77^{c} \pm 0.06$	$25.03^{d} \pm 0.03$	$7.51^{e} \pm 0.05$	$6.71^{f} \pm 0.02$

Data are presented as mean ± standard error mean (SEM) of triplicate determinations; mean values with different alphabetical superscript within the same row suggests a statistically significant difference ($P<0.05$); mg/AAE = milligram per ascorbic acid equivalent.

The reducing power of extracts of differently sprouted onions is expressed in Table 3 above. In all sample extracts (aqueous, methanol, and chloroform), a significantly ($P<0.05$) higher reducing power was observed in samples sprouted for six days compared to control and other days of sprouting. Further sprouting beyond six days (i.e. eight and ten days), resulted in decline in the reducing power of the sample extracts. In aqueous and chloroform extracts, the reducing power noticed for samples sprouted for eight days was non-significantly ($P>0.05$) higher than the un-sprouted (Day 0) while further sprouting for up to 10 days yielded a significantly ($P<0.05$) lower reducing power. This was not so in methanol extract as all sprouted samples recorded a significantly ($P<0.05$) higher reducing power compared to the control.

Result on the DPPH radical scavenging activity of differently sprouted onions is shown in Table 4. In all extracts (aqueous, methanol, and chloroform), onions sprouted for eight days recorded a significantly ($P<0.05$) higher DPPH radical scavenging activity compared to the control. Generally, it was noticed that as sprouting continued with respect to days, the DPPH radical scavenging activity increased until it attained a maximum activity on the eighth day. However, further sprouting after eight days yielded a decline in the free radical scavenging activity ($P<0.05$).

$ABTS^{+}$ radical scavenging activity (%) of sprouted onions is expressed in Table 5. In methanol and aqueous extracts, onions sprouted for eight days recorded significantly higher $ABTS^{+}$ radical scavenging activity compared to their respective controls. Extracts of onions sprouted for 10 days recorded a decline in its antioxidant activities compared to onions sprouted for 8 days.

Table 4: DPPH radical scavenging activity (%) of differently sprouted onions

Extracts	Days of Sprouting					
	Control (Day 0)	Day 2	Day 4	Day 6	Day 8	Day 10
Aqueous	$26.19^{a} \pm 2.38$	$37.05^{b} \pm 6.17$	$56.61^{c} \pm 3.55$	$66.19^{d} \pm 2.38$	$89.05^{e} \pm 4.76$	$67.95^{d} \pm 2.38$
Methanol	$27.16^{a} \pm 2.41$	$39.52^{b} \pm 8.60$	$60.18^{c} \pm 8.26$	$68.57^{d} \pm 4.12$	$94.52^{e} \pm 2.38$	$69.43^{d} \pm 4.12$
Chloroform	$24.38^{a} \pm 2.38$	$33.98^{b} \pm 3.43$	$45.77^{c} \pm 10.94$	$57.64^{d} \pm 4.73$	$65.96^{e} \pm 2.37$	$56.67^{de} \pm 2.38$

Data are presented as mean ± standard error mean (SEM) of triplicate determinations; mean values with different alphabetical superscript within the same row suggests a statistically significant difference ($P<0.05$).

Table 5: ABTS^{+} radical scavenging activity of sprouted onions

Extracts	Days of Sprouting					
	Control (Day 0)	Day 2	Day 4	Day 6	Day 8	Day 10
Aqueous	$42.81^{a} \pm 0.10$	$44.10^{b} \pm 0.16$	$48.06^{c} \pm 0.06$	$52.57^{d} \pm 0.06$	$61.50^{e} \pm 0.06$	$57.11^{f} \pm 0.06$
Methanol	$46.47^{a} \pm 0.16$	$49.97^{b} \pm 0.16$	$56.90^{c} \pm 0.06$	$59.32^{d} \pm 0.06$	$70.63^{e} \pm 0.11$	$61.39^{f} \pm 0.06$
Chloroform	$40.75^{a} \pm 0.16$	$42.70^{b} \pm 0.18$	$47.07^{c} \pm 0.06$	$51.56^{d} \pm 0.06$	$57.26^{e} \pm 0.06$	$53.71^{f} \pm 0.06$

Data are presented as mean ± standard error mean (SEM) of triplicate determinations; mean values with different alphabetical superscript within the same row suggests a statistically significant difference (P<0.05).

Ascorbic acid content (mg/g) of sprouted and boiled onions

The vitamin C (ascorbic acid) content of the onion that was sprouted for different days as well as the un-sprouted (Day 0) is shown in Fig. 1. A significantly (P<0.05) higher ascorbic acid content was recorded in onions sprouted for six days (6.29 mg/g). Thus, sprouting caused an increase in the ascorbic acid content of the onions.

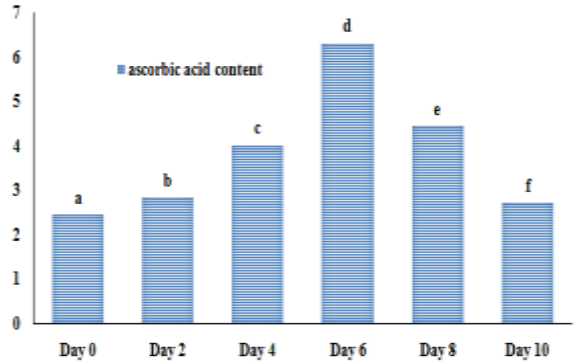

Fig. 1: Ascorbic acid content of differently sprouted onions; bars with different alphabets depict a statistically significant difference (P<0.05)

Allium crops are among the most widely consumed vegetables on a global basis and onion (*Allium cepa*) has long been used for medicinal purposes, owing to its anti-inflammatory and antimicrobial properties (Shitole and Wadaskar, 2014). Sprouting is a simple technological method that is used to germinate seeds and has been reported to improve the nutritive value of seeds (Amal *et al*., 2007). The results for phytochemical (total phenols, flavonoids, ascorbic acid) analyses and in vitro antioxidant assays show that sprouting for up to 8 days resulted in a significant (P<0.05) increase in all the parameters tested. This was followed by a slight but significant decrease at the 10th day of sprouting.

The results presented in the present study follow the reported pattern of Shitole and Wadaskar (2014). They sprouted for 0, 7 and 15 days and reported an increase in the total phenolic content of sprouted onions till day 7 and then further decrease with further sprouting for 15 days. In this present study sprouting was done for 0, 2, 4, 6, 8 and 10 days. This made it possible to determine when maximum antioxidant activities are achieved.

Flavonoids have been reported to interfere with the activities of the enzymes involved in reactive oxygen species generation, quenching of free radicals, chelating transition metals and rendering them redox inactive in the Fenton reaction (Aiyegoro and Okoh, 2009). One of the richest sources of flavonoids in human diet is common onion (*Allium cepa* L.) or shallot (*Allium ascaloni* L.) as reported by Kopec and Minárová (1985). Sellappan and Akoh (2002) also reported that onion is one of the rich sources of the main flavonols – quercetin – in human diet. Their flavonol content considerably decreases atherosclerotic processes, inhibits cholesterol accumulation in the blood serum and enhances resistance of vascular walls. Flavonoids also decrease a risk of coronary heart disease (Lachman *et al*., 2003). During sprouting phytochemical contents and antioxidant activities peaked at day 8. Majid *et al*. (2016) studied the effect of sprouting on the physicochemical, antioxidant and flavonoid profile of onion varieties. They observed a significant (P< 0.05) increase in total flavonoid content of sprouted onions compared to the raw ones. Therefore, sprouting of onions for between four to eight days may be a method to increase the total flavonoid content of onions to harness an improved antioxidant potential of the onions.

Ascorbic acid is one of the most powerful antioxidants (Arrigoni and De Tulloi, 2000, Horemans *et al*., 2000; Smirnoff, 2000) that scavenge harmful free radicals and other reactive oxygen species. It also regenerates other antioxidants like tocopherol to its functional state (Denre, 2014). The results from this study (fig. 1) agree with the report of Denre (2014) which recorded a significant (P<0.05) increase in the vitamin C content of onions as sprouting days increased. Xu *et al.* (2005) reported that increased ascorbic acid during sprouting is attributed to increased activity of enzyme (L-Galactono- c-lactonedehydrogenase) involved in the oxidation ofL-galactono-1,4-lactone to ascorbic acid.

From Table 3, the reducing power of all sprouted onion extracts was increased proportionately with the day of sprouting with the highest being observed on Day 6. Further increase above this day resulted in a decrease in the reducing power of the onions. This trend follows the same pattern with ascorbic acid. Ascorbic acid may therefore play a role in the reducing potential of onion extracts. Lean *et al.* (1999) asserted that plant polyphenols can act as reducing agents. Thus, higher phenolic compound possessed higher reducing potential.

In the DPPH radical scavenging activity, there was gradual but significant increase as the days of germination increased up to the 8th day. Cowie *et al*. (2008) recorded a significant (P<0.05) increase in the free radical-scavenging activity of onion and ginger as concentration of the extract and days of sprouting increased which corroborates the result of this study. According to Smith and Adanlawo (2014), 2,2-diphenyl-1-picril-hydrazil (DPPH) radical is a stable free radical that shows a maximum absorption at 517nm and is widely used to evaluate the free radical scavenging ability of natural compounds. As the electron becomes paired off in the presence of a free radical scavenger, the absorption vanishes; the resulting decolourization is stoichiometric with respect to the number of electrons taken up (Ayoola *et al*., 2008). The findings from the present studies contradict the results of Juániz *et al.* (2016). The studies of Guk *et al*. (2012) earlier reported that the DPPH radical scavenging activities of red pepper were reduced by 60.5%. In the present study, DPPH radical scavenging activities were reduced by 65% with methanol extract, 72 and 75% with aqueous and chloroform extract, respectively. HPLC analyses of the specific phenolic composition has shown that onions, especially the outer layers of the red variety contain quercetin and quercetin has been known to act by scavenging free radicals, chelating transition metal ions, and inhibiting oxidases (De Groot and Rauen, 1998; Lean *et al.*, 1999).

ABTS (2,2'-azino-bis (3-ethylbenzothiazoline-6-sulphonic acid)) is a chemical compound used to observe the reaction kinetics of specific enzymes (Shin *et al*., 2000). A common use for it is in the enzyme-linked immunosorbent assay (ELISA) to detect for binding of molecules to each other. ABTS is also frequently used by the food industry and agricultural researchers to measure the antioxidant capacities of foods (Huang *et al*., 2005). This study follows the reported pattern of Muhammad *et al*. (2015) who earlier reported that the ABTS value of sesame sprouts powder increased with increasing sprouting days. ABTS value is an indicator of antioxidant activity and onions sprouts is shown to have good antioxidant potential (Pasko *et al*., 2002). This study also agree with the study of Guk *et al*. (2012) who earlier reported that the ABTS radical scavenging activities of red pepper was reduced by 39.8~55.7%. In the present study, ABTS radical scavenging activities was reduced by 36% with methanol extract, 37 and 41% with aqueous and chloroform extract respectively. This falls within the same range reported earlier by Guk *et al*. (2012).

Conclusion and Recommendation

This study revealed that sprouting of onions may be a way of improving the antioxidant potential of onions. It is recommended that onions be sprouted for between 4 – 6 days before processing for consumption. Whether the improved antioxidant potential of bulbs resulting from sprouting could help Overcome losses resulting from cooking is suggested as a topic for further studies.

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Conflict of Interest

Authors declare that there is no conflict of interest related to this study.

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