ChemSearch Journal 13(2): 77 – 83, December, 2022
Publication of Chemical Society of Nigeria, Kano Chapter

Received: 01/11/2022 Accepted: 14/11/2022
http://www.ajol.info/index.php/csj

Comparative Evaluation of the Nutritional Qualities and Antioxidant Properties of Lotus (*lactuca sativa*) and Cress (*lepidium sativum*)

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ABSTRACT

Vegetables are important food plants which play a vital role in human health. This study evaluated and compared the nutritional qualities and antioxidant properties of Lotus (*Lactuca sativa*) and Cress (*Lepidium sativum*) using standard analytical procedures. Proximate analysis revealed that the percentage of crude protein (11.14± 0.03%), ash (18.30± 0.01%), crude fat (10.82± 0.17%) and carbohydrate (19.24±0.02%) were higher in cress while percentage moisture (32.21± 1.67%), crude fibre (18.18± 0.01%) and vitamin C (11.20± 0.09%) were higher in lotus. For mineral analysis, the concentrations of Mg(13.07± 0.67mg/ 100 g), K(180.70± 0.36mg/ 100 g), Fe(128.76± 1.07mg/ 100 g), and Na(173.70 ±3.14mg/ 100 g) were higher in cress while concentrations of Zn (96.81± 0.87mg/ 100 g) and Ca (0.57± 0.01 mg/ 100 g) were found to be higher in lotus. Higher antioxidant activities at various concentrations of the extract were observed in lotus sample than the cress sample. Based on the results obtained, the study revealed higher nutritional values in cress sample than the lotus sample but higher antioxidant activity was observed in the lotus sample. Therefore, this suggests that both samples can be used as good sources of minerals especially Zn, K and Fe and can also serve as good sources of natural antioxidants in diets.

Keywords: Antioxidant, Cress, Lotus, Minerals, Proximate

INTRODUCTION

The importance of vegetables in human diet cannot be overemphasized. Thus, vegetables are important food plants which play a vital role in human health. This is attributed to the presence of bioactive nutrient molecules such as vitamins, dietary fibre, and minerals, and non-nutritive phytochemicals such as flavonoids, phenolic compounds, bioactive peptides, among others(Sinha *et al.*, 2000;Habtamu*et al.*, 2004).Furthermore, several researches have also identified a large number of antioxidants in vegetables which also contribute significantly to human health when consumed in a diet (Mathew and Abraham, 2006; Jung *et al.*, 2003;Mathiventhan and Sivakaneshan, 2013). Thus, antioxidants such as vitamin A, C, E, β – carotene, glutathione precursors like selenium vitamin B2 (Riboflavin), B3 (Niacin), B6 (Pyridoxin), B9 (folic acid), B12 (cynacobalmin), bioflavanoids which are very rich in all seasonal fruits and vegetables with vivid colours stand as prophylactic (James, 1995). In addition, some very important micronutrient like chromium and vanadium which improve insulin sensitivity were also identified (Ogle *et al.*, 2001). However, based on the aforementioned, scientific studies revealed that adequate consumption of vegetables reduces the risk of chronic diseases such as diabetes, cardiovascular diseases, certain cancers, and obesity in the body(Caleb *et al.*, 2010; Nisha, *et al.*, 2012).

Minerals are inorganic substances needed by both plants and animals to enhance their growth and development. Thus, they are needed for proper formation of blood and bones, maintenance of healthy nerve function, heartbeat regulation, reproduction and foetal development among others. In addition, essential minerals such as calcium, magnesium and phosphorus help in building of bones and teeth. While non essential minerals such as selenium and zinc, help to boost the immune system in human body (Soetan *et al.*, 2010).

Antioxidants are substances that are capable of neutralizing free radicals in the body. Thus, they are capable of protecting the cells from the damage caused by the free radicals which initiate chain reactions leading to membrane and other lipid per oxidation, DNA damage among others (Kapadiya *et al.*, 2016). However, over the years, antioxidants have been used in both food processing and pharmaceutical industries as a preservative (to prevent oxidation), enhance flavour, aroma, colour and for the treatment of various diseases such as cancer and coronary heart disease respectively (Mathew and Abraham, 2006).

Lotus (*lactuca sativa*) comes under the family *Nelumbonaceae* which has various local tribal names (Indian lotus, bean of India, Chinese water lily, and sacred lotus) and several botanical names (*Nelumbium nelumbo, N. speciosa, N. speciousum*, and *Nymphaea nelumbo*). It is a perennial plant with both aerial and floating orbicular leaves. Aerial leaves are cup shaped and floating leaves have flat shape ovoid and glabrous. Tuberous roots are 8 inches long and 2 inches in diameter, smooth outer skin of the lotus root is green in colour (Komatsu *et al.*, 1975; Showemimo and Olanrewaju, 2004).

Cress (*lepidium sativum)* belongs to the family of *cruciferae* widely grown in India, Europe and US. It's an annually growing herbaceous plant that can reach a height of 5-13cm (2-5inches) with many branches on the upper parts(Lawande *et al.*, 1998). The leaves of this plant are used in cooking as they are extremely nutritious and also therapeutic in nature (Fasuyi, 2006). Generally, in Nigeria, cress is usually taken as a sauce or salad. Moreover, studies have shown that when supplemented in the diet of lactating women, it increasesthe milk secretion during the postnatal period and it is also recommended for diarrhea and dysentery(Taha *et al.*, 2018). However, this research work is aimed at comparative evaluation of the nutritional and antioxidant potentials of these vegetables (lotus and cress) grown in Nasarawa state, Nigeria.

MATERIALS AND METHODS

Sample collection and treatment

The samples (lotus and Cress) were obtained from three different farms in Nasarawa State, Nigeria. The samples were washed thoroughly to remove sand and other impurities and were taken to the laboratory where they were spread on a polythene sheet until they got dried. The samples were ground into fine powder using pestle and mortar and stored in an airtight polythene bag for further analyses.

Proximate Analysis

For proximate analysis, moisture, ash, crude fibre, crude protein (% N x 6.25) and ether extract (EE) were determined in accordance with the standard methods described by Association of Official Analytical Chemists(AOAC, 2012). The total carbohydrate content was estimated by difference. All the parameters in the samples were determined in triplicates and were expressed in percentage and the standard deviation of each parameter was computed. The chemicals used were all analytical grade.

Determination of Mineral Content

Mineral analysis was carried out after acid digestion of 2 g of the ground samples with 10 cm^3 of a mixture of nitric and hydrochloric acid in ratio 1: 3 (aqua regia 5 cm^3: 15 cm^3) until a clear solution was obtained. The digest was allowed to cool and then transferred into a 100 cm^3 standard flask and made up to mark with deionized water after which an aliquot was used for the analysis (Kassa and Hailay, 2014). The mineral elements were analyzed using Computer Control Thermo Fisher Scientific ICE 3000 series Atomic Absorption Spectrophometer (AAS) and flame photometer (model 405, corning, U.K).

Determination of Vitamin C

Vitamin C was determined using titrimetric method described by Barakat *et al*. (1973) with slight modifications. In this method, the vitamin C was determined by titration. Thus, 50 g of each sample was dissolved in 250 cm^3 beaker containing 100 cm^3 of distilled water and made up to mark with distilled water. The sample solution was strained via chesse cloth and the filtrate was collected. The filtrate (25 cm^3) was drawn using a pipette into a conical flask, ten(10) drops of 1% starch indicator solution were added and finally titrated against standard iodine solution (0.05 M).

Antioxidant Analysis

The free-radical scavenging activities of the samples were evaluated using 2,2-diphenyl-1-picrylhydrozyl radical (DPPH) in methanol by a slightly modified method of Re *et al.*(1999). According to the method, 1 cm^3 of 1 mM of DPPH in methanol was prepared under darkness and 3 cm^3 of this solution was added to 1 cm^3 of various concentrations(0.1, 0.3, 0.5, 0.7 and 1.0 mg / ml) of the extracts. Vitamin C was used as a standard. The absorbance value was taken after 30 minutes at 517nm and the radical scavenging activity was calculated as:

$$\text{Inhibition (\%)} = \frac{A - B}{A} \times 100$$

Where A = absorption of the blank sample without extract.

B = absorption of the extract.

RESULTS AND DISCUSSION

Proximate Composition

Table 1 shows the result of the proximate analysis of the Cress (*Lepidium sativum*) and lotus (*Latuca sativa)* samples. The percentage moisture content in both *Latuca sativa* (32.21%) and *Lepidium sativum* (25.09%) samples were found to be very high. This implies that both samples could be highly vulnerable to microbial attack hence they can easily perish or rotten (Aremu *et al.*, 2012; Jibrin *et al.*, 2020).This also justifies why the two samples are classified under perishable food items. Protein plays a vital role in the body in terms of growth, worn out tissues and also aids the brain cells to function well (Prakash and Pal, 1991; Mephba *et al.*, 2007). This study revealed that the percentage crude protein content in *Lepidium sativum* (11.14%) is higher than that in *Latuca sativa* (9.75%).Though, both samples showed very low crude protein contents when compared to the values ranged from 46.56% to 66.60% reported in other vegetables (Onwordi *et al.*, 2009).However, literature revealed that plant foods that provide more than 12% of their calorific value from protein could be good sources of protein (Asibey-berko and Tayikie, 1999). This shows that both the vegetables samples investigated are not good sources of protein.

The percentage ash content in *Lepidium sativum* (18.30%) was found to be higher than that in *Latuca sativa* (14.87%). Studies showed that the higher the ash the higher the mineral content (Nnorom *et al.*, 2015; Bamishaiye *et al.*, 2011). This implies that more mineral content is expected in the *Lepidium sativum* than the *Latuca sativa* samples. This study revealed that percentage crude fibre fell within the range of 15.41 to 18.18% in which the *Lepidium sativum* sample was found to have higher than *Latuca sativa* sample. Thus, researches had shown that when the percentage crude fibre is high in diets it helps to regulate the body's use of sugar and when it is low it results in unhealthy digestive system (Lyimo *et al.*, 2003).However, the values obtained from this study, are fairly higher than those reported by Asaolu *et al.* (2012) on some leafy vegetables but fell within the range of the reported values (8.50-20.90%) obtained in some Nigerian vegetables (Mohammed and Sharif, 2011). The percentage crude fat was found to be high in *Lepidium sativum* (10.82%) compared to *Latuca sativa* (8.95%). Fat is an important nutrient in human diets as it contributes substantially to high energy content in diets. But on contrary, high concentration of fat in human diets when consumed leads to different illness such as obesity, coronary heart disease and is therefore not desirable (Oyarekua and Eleyinmi, 2004) . However, the values obtained from this study are in close agreement with those reported by Hanif *et al.*(2006) in some leafy vegetables. Carbohydrate supplies energy to the cells of the brains, muscles and blood. It contributes to fat metabolism and spare proteins as an energy source and act as mild natural laxative for human beings and generally add to the bulk of the diet (Aremu *et al.*, 2012). From the result obtained, it shows that *Lepidium sativum* has higher carbohydrate (24.24%) content than *Lactuca sativa* sample (20.04%). This suggests that *Lepidium sativum* supplies more energy than *lactuca sativa*. The result also revealed that the calculated metabolizable energy in the samples is between 816.80 kJ/100g and 689.58 KJ/100g as shown in Table 1. However, the high amount of the calculated metabolizable energy (816.80 KJ/100g) obtained in the *Lepidium sativum* compared to *Lactucasativa* was due to the presence of high percentage of other components or nutrients (protein and fat) in the shell which also provide energy.

For the vitamin C contents, this study revealed higher concentration in *Latuca sativa* (11.20%) than *Lepidium sativum* (8.24 mg/100g).However, several studies revealed that deficiency of vitamin C in human body causes scurvy, bleeding gums, limbs pain and blindness(Lee and Kader, 2000; Smirnoff, 2000; Mathiventhan and Sivakaneshan, 2015). This implies that the high value of vitamin C content obtained in the *lactuca sativa* sample will be more effective in terms the role of vitamin in the body when consumed. Though, the values were low when compared with the daily dietary allowance of vitamin C for adults (45 mg/day) recommended by FAO (2002).

Table1: Proximate Compositions (%) of *Latuca sativa* and *Lepidium sativum*

Parameters (%)	*Latuca sativa*	*Lepidium sativum*
Moisture	32.21± 1.67	25.09± 0.61
Crude protein	9.75 ± 0.07	11.14± 0.03
Ash	14.87± 0.16	18.30± 0.01
Crude fibre	18.18 ± 0.01	15.41± 0.08
Crude fat	4.95± 0.02	5.82± 0.17
Carbohydrate	20.04±0.06	24.24±0.02
Energy	689.58± 2.10	816.80±3.71
Vitamin C	11.20± 0.11	8.24± 0.09

Mineral Analysis

From the results presented in Table 2, concentration of Zn in *Latuca sativa* (96.81 mg/ 100 g) was found to be slightly higher than that in *Lepidium sativum* (95.03 mg/100 g).Thus, zinc is an essential part of growth, sexual development and reproduction (Black, 2003). The values obtained from this study indicate that both samples are good sources of zinc when compared with the values obtained for Zn concentrations in some green leafy vegetables investigated by Najeeb *et al.* (2014). The concentration of magnesium in *Lepidium sativum* (13.07±0.67 mg/100 g) was found to be higher than that in *Latuca sativa* (8.38±0.01 mg/ 100 g). Studies revealed that Mg, helps in maintaining osmotic equilibrium and enzyme catalyze reactions in the body while its deficiency is associated with abnormal irritability of muscle and convulsions and its excess leads to depression of the central nervous system (Spencer *et al.*,1994; Rude and Shills, 2006).The values obtained from this study are comparatively much lower than *Premna latifolia* (30.6±2.3mg/ 100 g), *Pisoniagrandi s*(34.2±2.7 mg/ 100 g) and *C.*

halicacabum (74.3±3.6 mg/ 100 g) as reported by Arasaretnam *et al*. (2018). This suggests that both samples are poor sources of magnesium. Additionally, several scientific studies revealed that sodium and potassium are important intracellular and extracellular cations respectively. They are also involved in the regulation of plasma volume, acid-base balance, nerve and muscle contraction (Larsen *et al.,* 2006; Cheng *et al*., 2013). This study revealed the concentration of potassium in *Latuca sativa* to be 170.70±0.79 mg/ 100 g which is lower than 180.70±0.36 mg/ 100 g in *Lepidium sativum*. These values are comparatively higher than 127.3±2.4 mg/ 100 g and 114.9±4.4 mg/ 100 g obtained in *P. latifolia D. elata* respectively (Iheanacho and Ubebani, 2009). This suggests that the studied samples are rich sources of this mineral. The concentrations of sodium in *Latuca sativa* (121.6 ± 2.41 mg/ 100 g) was found to be lower than *Lepidium sativum* (173.7±3.14 mg/ 100 g) but the values in both samples were lower than the recommended dietary allowance in take for both adult (500 mg/day) and children(400 mg/day)(FAO (2012). Another finding revealed that the ratio of sodium to potassium (Na/K) of less than one is recommended for the prevention of high blood pressure (Okonkwo *et al.,* 2015). However, the values obtained(Table 2) in both samples are in agreement with the recommended value. This suggests that consumption of these samples is good for the prevention of high blood pressure. Research had shown that low concentration of iron leads to anaemia while high concentration leads to hemochromatosis which is a condition in the body when it stores too much iron (Woods and Rommenberg, 2006).This study revealed high concentration of iron in both *Lepidium sativum* (128.76±1.07 mg/ 100 g) and *Latuca sativa* (118.85±0.47 mg/ 100 g) compared to 5.01± 0.1 mg/ 100 g in *A. esculenthus*, 10.69± 0.4 mg/ 100 g in *S. melongena* 39.04 mg/ 100 g in *Amaranthus hybridus* and 34.47 mg/ 100 g in Indian spinach (Asaolu and Asaolu,2010). Investigation had shown that calcium plays a vital role in mediating the constriction and relaxation of blood vessels, nerve impulse transmission, muscle contraction, and the secretion of hormones like insulin(Weaver and Heaney, 1999). The concentrations of calcium in both samples were found to be low when compared to those vegetables reported in the literature (Nwanekezie *et al.,* 2014). This suggests that both samples are not rich sources of calcium compared to those reported in the literature.

Table 2:Minerals Concentrations (mg/100 g) in*Latuca sativa* and *Lepidium sativum*

Minerals (mg/100 g)	***Latuca sativa***	***Lepidium sativum***
Zinc	96.81± 0.87	95.03± 0.86
Magnesium	8.38± 0.01	13.07± 0.67
Potassium	170.70 ± 0.79	180.70± 0.36
Sodium	121.6 ± 2.41	173.70 ±3.14
Iron	118.85± 0.47	128.76± 1.07
Calcium	0.57± 0.01	0.43± 0.02
Na/K	0.71 ±3.10	0.96 ± 8.72

Antioxidant Activity

From the result (Table 3), it was observed that % inhibition increases with increase in the concentrations of both extracts of the two samples analysed (*Latuca sativa* and *Lepidium sativum*). This implies that the higher the concentration of the extract, the higher its antioxidant activity. The result also revealed that the % inhibition of *Latuca sativa* sample ranged from 37.25 to 70.80% while *Lepidium sativum* ranged from 27.12 to 66.84%. However, studies reveal that low antioxidant capacity allows free radicals to cause serious harm very quickly which eventually results to death while high antioxidant capacity helps in defending cells from damage caused by potentially harmful molecules known as free radicals(Sohn *et al.*, 2003; Wu *et al.,* 2003).From the results obtained, it could be inferred that the *Latuca sativa* sample has higher antioxidant potentials than the *Lepidium sativum* sample since it recorded the highest percent antioxidant activity(70.80%).

Table 3:Antioxidant Activities of *Lepidium sativum* and *Latuca sativa* (% IE)

S/N	**Conc. Extract (mg/ml)**	***Lepidium sativum***	***Latuca sativa***
1	0.10	27.12	37.25
2	0.30	43.79	54.25
3	0.50	52.29	67.97
4	0.70	58.82	67.65
5	0.90	66.84	70.80

CONCLUSION

Considering the results of the nutritional parameters and the antioxidant properties analysed in both samples, the cress sample had higher nutritional values than the cress sample while the lotus sample had higher antioxidant potential than the cress sample. Though, both samples could serve as good sources of nutrients especially for minerals such Na, K, Zn, and Fe and can also serve as natural antioxidants. This suggests that frequent and adequate consumption of these vegetables in a diet may reduce the effects of malnutrition and the risk of some chronic diseases such as diabetes, cardiovascular diseases and obesity as mentioned in the introduction.

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