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Proximate Composition, Phytochemical Screening and Antioxidant Activities of the Tubers of *Plectrantus edulis*

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Abstract

Plectranthus edulis is a tuberous crop found in western, central and southern Ethiopia. Despite the significant contributions of tuberous crops towards food security, the food potential of P. edulis has not been fully utilized due to poor consumer awareness of its nutritional value. In view of this, the proximate composition of the tuber of P. edulis grown in Ethiopia were determined and found to have ash content ranged from 1.5 to 1.8%, crude fat (1.1 to 1.8%), crude fiber (4.46 to 5.99%), moisture (69.00 to 75.00%), protein (6.65 to 10.24%) and carbohydrate (6.17 to 11.99%). The study showed that the protein, crude fat, carbohydrate, and fiber contents of the tuber of P. edulis were superior to those values reported for the tuber of sweet potato, suggesting the usefulness of the tuber of P. edulis as natural food. Chemical screening of the methanol extract showed the presence of terpenoids, flavonoids, phenolics, and cardiac glycoside while, alkaloids, tannins, and antraquinone glycosides were absent. The presence of these secondary metabolites recorded in the present study is known to have positive effects on health. The study also demonstrates that the tuber of P. edulis showed strong antioxidative activity in both ferric thiocyanate and DPPH assay which is likely attributed to the presence of phenolics. This adds one positive attribute to the nutritional and pharmacological importance of P. edulis. The findings create awareness amongst stakeholders regarding the potential of this crops both as food and medicine.

Keywords: Plectranthus edulis, proximate composition, antioxidant, Ethiopia.

Introduction

Plectranthus edulis Vatke (Lamiaceae) is among the four economically significant tuberous crops of the genus *Plectranthus*[1], along with *P. esculentus* (Livingstone potato), *P. parviflorus* (Sudan potato) and *P. rotundifolius* (Madagascar potato)[2]. It is used by peoples living in the central, western and southern parts of Ethiopia. *P. edulis* is locally called *Dinicha Oromo* in Oromia (western and central Ethiopia) and *Ye Walayta Dinich* in southern Ethiopia showing its wide distribution in these localities of the country.

P. edulis is an indigenous plant to Ethiopia growing in different mid and high altitude areas[3]. It is known in Ethiopia due to its horticultural uses since it is fast-growing, produce lovely flowers and are resistant to most pests and plant diseases. *P. edulis* is cultivated in Ethiopia for its edible tuber. In some parts of Ethiopia, the leaves are also eaten after cooking like vegetables. It is particularly important in local diets mainly between September and December since other food crops are not ready for consumption. This plant is also used as a source of income in regions of Ethiopia where it is cultivated. Furthermore, the tubers are traditionally claimed to have good for people with asthma.

Eating underutilized edible plants has been looked as a sign of poverty which is largely due to lack of knowledge on their nutritional benefits. *P. edulis* is among underused indigenous tuberous crops in Ethiopia owing to poor consumer awareness of its nutritional value. Therefore it is necessary to evaluate the nutritional profile of the tuber of this plant species. Furthermore there has been a growing interest in evaluating the antioxidant activities of plants that are used as food as they have significant impact on the status of human health and disease prevention. To the best of our knowledge, there is no scientific reports that assess the antioxidant activity of the tuber of *P. edulis*. Therefore, the radical scavenging and anti-lipid peroxidation potential of the extract of the tuber of *P. edulis* were also evaluated using DPPH and ferric thiocyanate method, respectively.

Materials and Methods

Sample Collection: The tubers of *P. edulis* were collected from Bako (Oromia), Guliso (Oromia) and Wollyat Sodo (southern Ethiopia), Ethiopia. The species were identified by Mr. Melaku Wondafrash of the National Herbarium of Addis Ababa University (Ethiopia), where voucher specimen YD005 are deposited.

Analysis of Proximate Composition: Oven drying method was employed for the determination of moisture contents[4]. In this regards the sample was dried at 100-105^{o}C for 6-12 h. Total ash (muffle furnace at 550^{0}C for 8 h)[4], crude protein (Kjeldahl

method, %N x 6.25)[5], crude fat (Soxhlet extraction system) and fiber were determined in accordance with standard procedure[4]. The formula 100-(crude protein + lipid + crude fiber + moisture + ash contents) was used to estimate the total percentage carbohydrate[6]. Likewise, the energy value of the samples = (protein content x 4) + (carbohydrate content x 4) + (fat content x 9)[4,6]. All tests were carried out in triplicates.

Phytochemical Screening: The methanol extract of the tuber of *P. edulis* was assessed for the presence or absence of alkaloids, saponins, tannins, cardiac glycosides, antraquinone glycosides, phenolics and flavonoids using the protocols previously described[7-10].

Antioxidant Activity: Diphenylpicrylhydrazyl radical (DPPH) Assay: DPPH radical scavenging assay was employed for the *in vitro* radical scavenging activity of the methanol extract of the tuber of *P. edulis*[11]. Serial dilutions were carried out with the stock solutions (1 mg mL^{-1}) of the extract to obtain concentrations of 50, 25, 12.5, and 6.5 µg mL^{-1}. The DPPH and sample solutions were prepared using methanol as solvent. Diluted solutions (1 mL each) of the sample were mixed with 4 mL of DPPH (0.04 mg/mL) in brown vials. After an incubation period of 30 min at 37°C in an oven, the absorbance was determined against a blank at 517 nm[12]. The percent radical scavenging activity of the samples was calculated according to the formula[13]:

$$(\%)\ \text{inhibition} = \frac{(\text{A control} - \text{A sample})}{\text{A control}} \times 100$$

Where A control was the absorbance of the DPPH solution and A sample was the absorbance in the presence of plant extract[13]. The IC_{50} value, defined as the concentration of a substrate that causes 50% loss of the DPPH activity, was calculated by linear regression plots of the percentage inhibition against the concentration of the tested samples. Samples were analyzed in triplicate. Ascorbic acid was used as positive control.

Thiocyanate Method: The anti-lipid peroxidation potential of extract of the tuber of *P. edulis was* also evaluated using thiocyanate method[14]. Each 0.1 mg EtOH extract of tuber of *P. edulis*, 100 µL of linoleic acid, EtOH (5 mL) and phosphate buffer (5 mL, 0.05 M, pH = 7) in water were separately added in to a vial and incubated at 40°C in an oven. After 24 h, 0.1 mL from each were taken and added in to a vial containing 75% aqueous EtOH (7 mL), 30% of NH_4SCN (0.15 mL) and 0.15 mL of 0.02M $FeCl_2$ in 3.5% HCl. Each was then subjected to UV-Vis spectrophotometery to record the absorbance at 500 nm. Absorbance of the blank and ascorbic acid were done in the same fashion. The percentage inhibition using ferric thiocyante method was calculated employing the following formula.

$$\text{Percentage inhibition} = 100 - \left(\frac{As}{Ab} \times 100\right)\%,$$

where As is absorbance of the sample and Ab is absorbance of the blank[15].

Results and Discussion

Proximate Composition: This present study was conducted to evaluate the nutritional profile of three samples of the tubers of *P. edulis* grown in different parts of Ethiopia. Using standard procedures, the proximate composition of samples collected from Bakko, Guliso and Wolayta Sodo were determined and presented in Table 1. The results (Table-1) showed that the tuber of *P. edulis* contained low values of ash and crude fat. In common with other roots and tubers[16], the tuber of *P. edulis* has high moisture content resulting in relatively low dry matter content. The moisture content is an indicator of water activity. The level is a measure of its susceptibility to microbial contamination[6]. The high moisture content displayed by the tuber of *P. edulis* reveals that the sample need proper care for preservation as they will be prone to deterioration. On the other hand, the high moisture content provides for greater activity of water soluble enzymes and co-enzymes[7]. The high water content can also be taken as one positive attributes of the tuber as our body require quite low energy for digestion and assimilation of nutrients.

As many report shows excess intake of crude fat had some devastating health implications especially for the overweight[6]. One of the major problems associated with the use of excess fats is the increased level of cholesterol. In this regard, the low fat content displayed by the three samples of the tuber of *P. edulis* may decrease not only the risk of coronary heart disease but also lower the risk of hypertension. This low value of fat observed in this study is also significant as it is safe for consumption by mankind in the era where obesity poses a serious health problem. The tuber of *P. edulis* comprised of significant amount of protein. The higher protein contents of the tuber of *P. edulis* studied indicates that its intake can contribute to the formation of hormones which controls various body functions including growth, repair and maintenance of body. In addition, it may be taken as a preferred option to animal proteins for diabetics as the later tend to be high in saturated fats. This confirms that the tuber of *P. edulis* is an energy-giving food[4]. The protein content of the tubers of *P. edulis* is superior to the values reported for the tuber of sweet potato (0.91%)[16] and *Dioscorea rotundata,* yam (0.7%)[17]. Furthermore, the value was found comparable with the protein content reported for *Amorphophallus campanulatus* (9.8%)[18].

The presence of such significant amount of carbohydrate in the tuber of *P. edulis* has beneficial effects on human health. It can serve as a good source of carbohydrate which constitutes a major class of naturally occurring organic compounds that are essential for the maintenance of animal life. In addition, carbohydrates may serve as precursors for the biosynthesis of amino acids with aromatic side chains and phenolic compounds. Thus the level of carbohydrate obtained in the present study suggests the use of *P. edulis* as a source of glucose. The energy value of the tuber of *P. edulis* from Bako and Guliso were turned out to be higher than Wolayta Sodo (Table-1). The

presence of fiber in foods is useful in the management of cardiovascular disease[19], diabetes mellitus, colorectal cancers and weight reduction in obsessed individuals[4]. Though excess amount of food fiber reduces absorption of nutrients, and result in insufficient energy for growth in children[19], they have also some positive attributes. The presence of significant amount of fiber in the tubers of *P. edulis* is significant as it is effective in combating many life threatening diseases. It is also needed in the diet to aid digestion and absorption of glucose and fat.

Phytochemical Screening: The preliminary phytochemical screening of the methanol extract of the tuber of *P. educlis* revealed the presence of terpenoids, flavonoids, phenolics, and cardiac glycoside while, alkaloids, tannins, and antraquinone glycosides were absent. The presence of phenols, terpenoids, cardiac glycosides and flavonoids (Table 2) recorded in the present study is known to have some positive effects on health. For instance the presence of phenols and flavonoids in *P. edulis* is important as it is reported to decrease the incidence of some cancers and cardiovascular diseases[20].

Antioxidant Activity: DPPH Radical Scavenging Assay: DPPH radical scavenging assay is a simple and common method widely used as an index to estimate the antioxidant activities of medicinal plants. The scavenging activity was expressed in terms of percent inhibition and $IC_{50,}$ with latter defined as the amount of active extracts necessary to decrease the initial DPPH absorbance by 50%. Results showed that the methanol extract of the tuber of *P. edulis* changed the purple colored DPPH solution into yellow. This is a clear indication of the radical scavenging potential of the extract. The percent inhibition of the methanol extract of the tuber of *P. edulis* was 84% at 100 µg/mL which is comparable with ascorbic acid (90% at 100 µg/mL), indicating its strong activity as radical inhibitor. It was also observed that the radical scavenging activities of the extract increased with increasing concentration (Table-2).

Table-1
Proximate composition of the tuber of *P. edulis* grown in Ethiopia

Parameters	%composition of *P. edulis* from			Sweet potato[16]
	Bakko	Guliso	Wolayta Sodo	
Moisture	74.0±1.24	69.0±1.43	75.0±1.80	64.34± 0.42
Ash	1.80±0.03	1.7±0.04	1.50±0.03	0.40 ± 0.02
Crude protein	9.02±0.12	6.65±0.00	10.24±0.13	0.81 ± 0.09
Crude fat	1.80±0.04	1.6±0.06	1.10±0.02	
Crude fiber	5.16%±0.05	4.46%±0.04	5.99%±007	0.12 ±0.01
Nitrogen free extract	8.22±0.09	11.19±0.12	6.17±0.04	2.04 ±0.01
Nitrogen content	1.44±0.11	1.06±0.0	1.64±0.12	0.13 ±0.01
Energy value	85.08Kcal/100g	85.76Kcal/100g	75.54Kcal/100g	

The experiments were done in triplicates. Mean ± standard deviation were taken.

Table-2
Percent inhibition and IC_{50} values of the MeOH extract of the tuber of *P. edulis*

Samples tested	Concentration in µg/mL	%DPPH inhibition	IC_{50}	Remark
P. edulis MeOH extract	100	84±0.92	6.1	
	50	70±1.20		
	25	62±1.30		
	12.5	50±0.89		
Ascorbic acid	100	90±0.45	3.1	

Values are mean ± standard error of triplicate analysis.

The presence of phenolics received much attention as potential natural antioxidant[21]. Their antioxidant activity is due to their ability to act as radical scavengers and metal chelators. Phenolics also act as hydrogen donors and singlet oxygen quenchers. The high DPPH radical scavenging activity displayed by the tuber of *P. edulis* is likely ascribed to the presence of phenolics. This is in agreement with the chemical screening test which showed the presence of phenolic compounds in the tuber of *P. edulis.*

Ferric thiocyanate method: The degree of lipid per-oxidation can be used to indicate the antioxidant potential of extracts or pure constituents. As depicted in Table-3, the MeOH extract of the tuber of *P. edulis* inhibited primary peroxide formation by 78% at 100 µg/mL. The result was turned out to be comparable with ascorbic acid, demonstrating the potential of the tuber in preventing the formation of lipid peroxides. Therefore the strong activity displayed by the tuber of *P. edulis* indicates the potential of the plant as natural antioxidants. It can further improve the health status of its users.

Table-3
Anti-lipid peroxidation activities of the MeOH extract of *P. edulis*

Sample name	Absorbance at 500 nm	%inhibition	Remark
Blank	0.56	-	
Ascorbic acid	0.11	80	
*P. edulis Me*OH extract	0.12	78	

Ascorbic acid was used as positive control; values are mean of triplicate analysis.

Conclusion

The present study shows that the tuber of *P. edulis* is good sources of carbohydrates and proteins. It also contains secondary metabolites including phenolics, terpenoids, cardiac glycosides and flavonoids that are needed to combat various kinds of diseases. Our study also demonstrates that the methanol extract displayed pronounceable antioxidative activity in both ferric thiocyanate and DPPH radical scavenging assay which may be attributed to the presence of phenolics and flavonoids. This adds one positive quality to the nutritional and pharmacological importance of the tuber of this species. Furthermore, the findings is significant at it may create awareness amongst stakeholders regarding the potential of this crops both as food and medicine.

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References

1. Taye M., LommenW.J.M. and Struik P.C. (2012). Ontogeny of the tuber crop *Plectranthus edulis* (Lamiaceae). *African Journal of Agricultural Research*, 7(30), 4236-4249.

2. Rice L.J, Brits G.J, Potgieter C.J. and Staden J.V. (2011). *Plectranthus*: A plant for the future?. *S Afr J Bot.,* 77, 947–959.

3. Taye M., Lommen W.J.M. and Struik P.C. (2007). Indigenous Multiplication and Production Practices for the Tuber Crop *Plectranthus Edulis* in Chencha and Wolaita. *Southern Ethiopia, Expl Agric.,* 43, 381–400.

4. Gul S. and Safdar M. (2009). Proximate Composition and Mineral Analysis of Cinnamon. *Pakistan Journal of Nutrition*, 8(9), 1456-1460.

5. Moses O., Olawuni I. and Iwouno J. (2012). The Proximate Composition and Functional Properties of Full-Fat Flour, and Protein Isolate of Lima Bean (*Phaseolus Lunatus*). *Open Access Scientific Reports,* 1(7), 1-7.

6. Bhattacharjee S., Sultana A., Sazzad M.H., Islam M.A. and Ahtashom M.M. (2013). Analysis of the proximate composition and energy values of two varieties of onion (*Allium cepa* L.) bulbs of different origin: A comparative study. *International Journal of Nutrition and Food Sciences,* 2(5), 246-253.

7. Asaolu S.S., Adefemi O.S., Oyakilome I.G., Ajibulu K.E. and Asaolu M.F. (2012). Proximate and Mineral Composition of Nigerian Leafy Vegetables. *Journal of Food Research*, 1(3), 214-218

8. Mamta S. and Jyoti S. (2012). Phytochemical screening of *Acorus calamus* and *Lantana camara*. *J. Int Res Pharm.* 3(5),119-123.

9. Sindhu C.G. (2010). Phytochemical screening of *Calendula officinalis* Linn leaf extract by TLC. *J. Int Res Ayurveda Pharm.*, 1, 131-134.

10. Doherty V.F., Olaniran O.O. and Kanife U.C. (2010). Antimicrobial activity of *Aframomum melegueta* (*Allegator pepper*). *J. Int Biol.*, 2(2), 63-67.

11. El-Sharabasy F. and Mohamed N.Z. (2013). Chemical Constituents and Biological Activity from Chloroform Extract of *Zilla spinosa. International Journal of Pharmacy and Pharmaceutical Sciences*, 5(1), 422–427.

12. Ghasemi K., Ghasemi Y. and Ebrahimzadeh M.A. (2009). Antioxidant Activity, Phenol and Flavonoid Contents of 13 Citrus Species Peels and Tissues. *Pak. J. Pharm. Sci.*, 22(3), 277–281.

13. Qusti S.Y., Abo-Khatwa A.N. and Lahwa M.A.B. (2010). Screening of Antioxidant Activity and Phenolic Content of Selected Food Items Cited in the Holly Quran. *EJBS.* 2(1), 40–52.

14. Nagatsu A. (2004). Investigation of Anti-oxidative Compounds from Oil Plant Seed. *FABAD J. Pharm. Sci.*, 29, 203–210.

15. Gulcin I., Huyut Z., Elmastas M. and Aboul-Enein H.Y. (2010). Radical Scavenging and Antioxidant Activity of Tannic Acid. *Arabian Journal of Chemistry*, 3, 43–53.

16. Rose I.M. and Vasanthakaalam H. (2011). Comparison of the Nutrient composition of four sweet potato varieties cultivated in Rwanda. *American Journal of Food and Nutrition*, 1(1), 34-38.

17. Alinnor I.J. and Akalezi C.O. (2010). Proximate and Mineral Compositions of *Dioscorea rotundata* (White Yam) and *Colocasia esculenta* (White Cocoyam). *Pakistan Journal of Nutrition*, 9(10), 998-1001.

18. Basu S., Das M., Sen A., Choudhury U.R. and Datta G. (2014). Analysis of Complete Nutritional Profile of *Amorphophallus Campanulatus* Tuber Cultivated in Howrah District of West Bengal, India. *Asian J Pharm Clin Res.,* (3), 25-29.

19. Ezeokonkwo M.A. and Okafor S.N. (2015). Proximate Composition and Mineral Analysis of *Mucuna utilis* (Velvet Bean). *IOSR Journal of Applied Chemistry,* 8(10), 42-45.

20. Bouba A.A., Njintang N.Y., Foyet H.M., Scher J., Montet D. and Mbofung C.M.F. (2012). Proximate Composition, Mineral and Vitamin Content of Some Wild Plants Used as Spices in Cameroon. *Food and Nutrition Sciences*, 3, 423-432.

21. CA Rice-evans, NJ Miller, PG Bolwell (1995). The relative antioxidant activities of plant derived polyphenolic flavonoids. *Free Rad Res*. 63(4), 375–383.