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QUALITATIVE AND QUANTITATIVE EVALUATION OF BIOACTIVE PHYTOCHEMICALS IN LEAF POWDER OF WIDELY GROWN PURSLANE *(PORTULACA OLERACEA)*

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ABSTRACT

Some of our locally available underutilized crops are rich in phytochemicals with numerous untapped health benefits. The study evaluated the qualitative and quantitative bioactive phytochemicals in leaf powder of widely grown purslane (Portulaca oleracea). Fresh leaves of Portulaca oleracea collected from International Academy of Ethnomedicine, Igbuzo, Delta State, Nigeria were sorted, surfaces sterilized after washing them thoroughly in tap water to remove adhering dust and particles. The fresh cleaned leaves were dried under shade at room temperature, grinded into powder, and packaged. This was followed by the determination of its qualitative and quantitative bioactive phytochemical properties using standard analytical process. Data generated were statistically analyzed using the SPSS version 23.0 and results presented as means and standard deviations. The results indicated that the vegetable had more abundant (qualitative property) of alkaloid, flavonoid, terpenoids, total phenolics and reducing sugars, respectively; and less abundant of steroids, tannins, and glycosides while saponin was not detectable. Quantitatively, it contained 359 ± 16.10mg total phenolics, 131.11 ± 8.50mg alkaloid, 80.7 ± 3.29mg reducing sugar and no quantity of saponin was detected. The study showed that widely grown purslane (Portulaca oleracea) leaf powder was qualitatively and quantitatively rich in bioactive phytochemicals. We need to join hands in harnessing the potentials embedded in this underutilized vegetable by creating massive awareness on the benefits in not only helping to mitigate the cause of many diet-related non-communicable chronic diseases but also in the prevention and management of some chronic and degenerative diseases.

Keywords: Antioxidants, Bioactive, Degenerative diseases, Functional foods, Phytochemical, Portulaca oleracea, Underutilized foods

INTRODUCTION

Portulaca oleracea belongs to family *Portulacaceae*: an herbaceous weed widely spread out in the world though not known as edible vegetables and it is either not utilized or underutilized by many people in various communities where it grows commonly. It is commonly known as purslane, pigweed, fatweed, or little hogweed. It is known as Fasa kasa in Hausa, Papasan in Yoruba, Efere Makara in Efik and Nti oke in Igbo. In warm temperate, tropical, and subtropical climates across the globe, it is a ubiquitous weed. Ever since antiquity, purslane has been considered a significant weed of both vegetables and other crops (Md *et al.,* 2014). It is said in folk medicine that it can be prepared like soups and served as a salad. It has a sour, slightly salty taste (Samy *et al.*, 2004) like watercress and spinach and it can be eaten by adding it to salads and sandwiches. It is a versatile plant that can grow in arid climates with little water, excessively salted soil, and soil deficient in minerals. *Portulaca oleracea* is easily able to adjust to changes in climate brought about by global warming. It has been used as food for a variety of purposes as a kitchen vegetable since prehistoric times and in some countries even today and it is equally seen as nourishing wonder crop because of its high nutritional value and acceptance into the human diet (Simopoulos *et al.,* 1995; Manju *et al.,* 2023). Because of its high nutritional and medicinal values, *Portulaca oleracea* is referred to as the "power food of the future" and promising wonder crop (Manju *et al.,* 2023). The quest for underutilized functional foods rich in bioactive phytochemicals began to gain attention due to the unabating high prevalence of diet-related non-communicable chronic diseases and degenerative diseases. Portulaca oleracea has a lot of non-nutritional potentials all tied to the bioactive phytochemicals and other non-nutritional components in it. Due to multiple benefits of *Portulaca oleracea*, it has become an important wonder crop and various scientists across the globe have shown much interest in it as a healthy food for the future (Ajay *et al.,* 2022). Numerous medicinal characteristics have been recorded for *Portulaca oleracea.* It is known to have anti-proliferation, anti-inflammatory, anti-hyperlipidaemia, and antidiabetic effects (Gai-Guo *et al.,* 2006; Agyare *et al.,* 2005; Zidan *et al*., 2014; El-Sayed 2011). According to Lee *et al.* (2012), purslane helped to improve vascular inflammation. It has also been shown to lower the incidence of cancer and heart diseases in areas where it is eaten (Naeem *et al.,* 2013), and this may be due to the presence of several active compounds found in *Portulaca oleracea*: "flavonoids, omega-3 fatty acids, polysaccharide, alkaloids, coumarins, cardiac glycosides, anthraquinone glycosides, β-carotene, melatonin, dopamine, noradrenalin (Lim & Quah 2007; Simopoulos *et al.,* 2005). It is reported to possess much pharmacological potential which includes: "neuronal activity (Abdel *et al.,* 2012), neuroprotective (Wayin *et al.,* 2007), antinociceptive and anti-inflammatory activity, antioxidant, anticancer, antidiabetic, hypocholesteremic, neuroprotective, hepatoprotective, nephroprotective, anti-inflammatory, antiulcer, antimicrobial, wound healing, uterine bleeding control and wormicidal and insecticidal activities (Wayin *et al.,* 2007). Regarding its neuroprotective properties, the β-cyanins of *Portulaca oleracea* were found to increase the activities of the following

enzymes: glutathione reductase, catalase, superoxide dismutase, and glutathione peroxidase; additionally, after β cyanins were administered to D-galactose-treated mice, a decrease in malondialdehyde (a lipid peroxidation product) was observed, signifying the compound's neuroprotective effects (Wang & Yang 2010). The anti-inflammatory activity of *Portulaca oleracea* cannot be overemphasized. By reducing nuclear factor κB (NF-κB), binding TNF-α-induced NF-κB and degrading (IκB) α molecule inhibition, suppressing tumor necrosis factor, and regulating vascular inflammatory process, its extract in water shown dose-dependent anti-inflammatory efficacy (Lee *et al.,* 2012). The leaf extract of *Portulaca oleracea* equally exhibited hypolipidaemic activity in dyslipidaemic rabbits treated orally for twelve weeks (Movahedian *et al.,* 2007). According to Mohammed and El-Sayed (2011), *Portulaca oleracea se*eds may have potential applications as a complementary treatment for type 2 diabetes due to their antidiabetic and dyslipidaemic properties. Sankara *et al.* (2012) equally reported that test extract (200 and 400mg/kg) of ethanolic extract of leaves of *Portulaca oleracea* showed significant inhibition against dexamethasone induced dyslipidaemia in adult Wistar rats for 8 days; all the parameters showed a significant decrease when the test extract is compared with the standard gemfibrozil. Also, Dae Gill *et al*. (2012) asserted that *Portulaca oleracea* suppress the hyperglycemia and diabetic vascular inflammation and prevent the development of diabetes and its vascular complication. This statement was as a result of their study in which mice with rosiglitazone induced diabetic was placed on 300mg/kg/day for ten days and the blood glucose, plasma triglyceride and LDL-C, and systolic blood pressure of the diabetic mice reduced significantly. The anti-microbial properties of *Portulaca oleracea* is equally worthy of note. The antimicrobial activity of aerial parts of chloroform and ethanolic extracts of *Portulaca oleracea* by agar diffusion method against five bacteria and three fungi; and the ethanolic crude extract showed maximum effect on organisms like *Staphylococcus aureau*, *Klebisilla pneumonia* and *Nerospora crassa* (Ramesh & Hanmantappa 2011). A modest impact was observed by the chloroform extract on *Aspergillus niger, Nerospora crassa, and Klebisilla pneumoniae*. The antimricrobial potentials could be the reason the leaf of this plant is use in the treatment of burn, skin eruptions (e.g. boil and carbuncle), in protecting skin from pollution and premature aging and its use in some skin lotion (Chekuri *et al.,* 2013).

MATERIALS AND METHODS

The research was conducted at Shalom Laboratory, Nsukka, Enugu State, Nigeria.

Collection of *Portulaca Oleracea* Leaf and Preparation of the Leaf Powder

Fresh leaves of widely grown *Portulaca oleracea* were collected from International Academy of Ethnomedicine, Igbuzo, Delta State, Nigeria (affiliated to Davinci Institute of Holistic medicine, lanaca, Cyprus), and its identification authenticated by the Department of Plant Science and Biotechnology, University of Nigeria, Nsukka. The leaves were sorted, surfaces sterilized after washing them thoroughly in tap water to remove adhering dust and particles. The fresh cleaned leaves were dried under the shade at room temperature, the dried leaves were grinded into powder, and packaged. This was followed by the determination of the qualitative and quantitative bioactive phytochemical properties of the sample using standard analytical process. Data generated were statistically analyzed using the SPSS version 23.0 and results presented as means and standard deviations.

Qualitative Determination of Bioactive Phytochemical Contents of *Portulaca Oleracea*

The qualitative values of flavonoid, alkaloid, steroids, terpenoids, tannins, total phenolic, reducing sugars, glycosides, and saponin of the sample were determined using the method of Harborne (1973).

Flavonoid Determination

A quantity (0.5g) of the test sample was boiled in ethylacetate (10mL) for 3 minutes, filtered and was shaken with 1mL of diluted ammonia solution. The layers were allowed to cool and the presence of intense yellow colouration showed the presence of flavonoids.

Alkaloid Determination

A given quantity (5g) of the test sample was added in 6mL of hydrochloric acid and boiled. It was then cooled and filtered, the filtrate was then divided into 3 parts and the following tests done on them. In the first parts of the filtrate, 2 drops of Dragendorff's reagent were added. The formation of red precipitate signified the presence of alkaloids. In the second parts of the filtrate, 2 drops of Meyer's reagent were added. The presence of creamy white precipitate implied that alkaloids was present. To the last part of the filtrate, 2 drops of Wagner's reagent were added. A reddish-brown precipitate revealed the presence of alkaloids.

Steroids Determination

A given quantity of the test sample was extracted in the chloroform and filtered. The filtrate was mixed with 2mL of concentrated sulphuric acid so that the sulphuric acid formed a lower layer. A reddish-brown interface indicated the presence of steroids.

Terpenoids Determination

Adopting the method of Harborne (1973), Okafor & Ezejindu (2014), 9mL of ethanol was added to 1g of the extract and refluxed for a few minutes and filtered. The filtrate was concentrated down to 2.5mL in a boiling water bath. The distilled water (5mL) was added to the concentrated solution and the mixture was allowed to stand for an hour and the waxy matter was filtered off. The filtrate was extracted with 2.5mL of chloroform extract was evaporated to dryness in a water bath and dissolved in 3mL of concentrated sulphuric acid and then heated for 10 minute in a water bath. A grey-colour indicated the presence of terpenoids.

Tannins Determination

Adopting the method by Harborne (1973) method, 0.5g of the test sample was added to 10mL of deionised water and then treated with 0.1% ferric chloride. A greenish-brown or blue-back precipitate showed the presence of tannins.

Total Phenolic Determination

This was determined using Harborne (1973) method. The test sample 0.1g was added to 10ml of distilled water. The solution was heated in a boiling for 3 minute and filtered. A 2mL aliquot of the filtrate was placed in each of 3 test tubes. The filtrate in one of the test tubes was diluted with distilled water in the ratio of 1:4. A blue of greenish colour indicated the presence of total phenolic.

Reducing Sugars Determination
Five millilitre (5mL) of a mixture of equal part of Fehling's solution A and B was added in 0.5g of test sample and heated in a water bath for 5 minutes. The formation of brick red precipitate indicated the presence of reducing sugars.

Glycosides Determination
Five millilitre (5mL) of diluted sulphuric acid was added to 0.1g of test sample in a test tube and this was boiled for 15 minutes in a water bath. This was cooled and neutralized with 20% potassium hydroxide solution. Ten millilitre if a mixture of equal parts of Fehling's solution A and B was added and boiled for 5 minutes. The presence of a denser brick red precipitate indicated the presence of glycosides.

Saponin Determination
Using the method of Harborne (1973), Obadoni & Ochuko (2001), 2g of the test sample was boiled in 20mL of distilled water in a water bath and filtered. Ten millilitre of filtrate was mixed with 5mL of distilled water and shaken vigorously for a stable persistent froth. The frothing was mixed with few drops of olive oil and shaken vigorously, then observed for the formation of emulsion which was an indication of saponin presence.

Quantitative Determination of Bioactive Phytochemical Contents of *Portulaca Oleracea*
the quantitative values of flavonoid, alkaloid, steroids, terpenoids, tannins, total phenolic, reducing sugars, glycosides, and saponin of the sample were determined using the methods below:

Flavonoid Determination
The method of Boham & Kocipai-Abyazan (1974) was used to determine the flavonoid content of the sample. Two gram of the sample was weighed into a conical flask and extraction done using 25mL of 80% aqueous methanol at room temperature. The mixture was shaken vigorously and allowed to stand for 2 hours after which it was filtered using Whatman filter paper into a pre-weighed dry crucible and evaporated to dryness over a water bath. The crucible was reweighed, and the percentage of flavonoid was calculated using this equation:

$$\%\text{Flavonoid} = \frac{(\text{weight of crucible} + \text{filtrate}) - \text{weight of crucible}}{\text{weight of sample used}} \times \frac{100}{1}$$

Alkaloid Determination
The sample's alkaloid content was ascertained gravimetrically using the method outlined by Harborne (1973). Five grams of the test sample were measured with a weighing balance and added to 50 milliliters of ethanol containing a 10% acetic acid solution. After giving the combination a thorough shake, it was left to stand for roughly four hours before being filtered. On a heated plate, the filtrate was evaporated to a quarter of its initial volume. To precipitate the alkaloids, concentrated ammonium hydroxide was added drop by drop. The precipitate was removed using pre-weighed filter paper, which was then cleaned with 1% ammonium hydroxide solution. After being dried for 30 minutes at 60°C in an oven, the filter paper holding the precipitate was placed in desiccators to cool, and it was then weighed again until a consistent weight was achieved. A record of the consistent weight was made. The weight difference of the filter paper was used to calculate the weight of the alkaloid, which was then stated as a percentage of the weight of the sample under analysis.

Saponin Determination
Using Obadani & Ochuko (2001) technique, this was ascertained. Two hundred milliliter (200mL) of 20% ethanol were added to a beaker along with two grams of the sample. This was continuously stirred and cooked to around 55°C, over a four-hour period over a water bath. After filtering this combination, 100 milliliters of 20% ethanol were used to extract the residue once more. Concentrated sample was heated to 90°C over a water bath. Two hundred and fifty milliliter (250mL) separating funnel with concentration was filled. This was washed with 20mL of diethyl ether. The aqueous layer was recovered while the ether layer was discarded. And 10mL of n-butanol was added into the extract and the mixture was shaken vigorously. Then, 10mL of 5% aqueous NaCl was added and the mixture was shaken, the lower layer was discarded while the upper layer (the Saponin layer) was retained in a pre-weighed evaporating dish. The test sample was subjected to evaporation in the water bath. The dry sample was sent to the oven for final drying after which it was weighed. A percentage estimate of the saponin content was computed.

Determination of Steroids
The method of Trease & Evans (1989) was used in determination of steroids in this test sample. After macerating 1g of the test material in 20mL of ethanol, it was filtered. Two milliliters of the chromagen solution were added to the filtrate, and the mixture was allowed to stand for thirty minutes. Thereafter, 550 nm was the absorbance reading.

Determination of Terpenoids
The leaf powder (1g) was macerated with 20mL of ethylacetate for 5min and filtered. And 2.5mL of concentrated H_2SO_4 and 2.5mL of 5% aqueous phosphomolybdic acid solution were added to the filtrate (2.5mL) and stirred. Following a half-hour of standing, 12.5mL of ethanol were added to the mixture. At 700 nm, the absorbance was measured (Trease & Evans 1989).

Determination of Tannins
The conventional technique was used to estimate the sample's tannin concentration (Harborne 1973). Folin-Clocalteau's reagent (0.5m) was combined with the sample (1mL), and then 1mL of saturated Na_2CO_3 solution and 8mL of distilled water were added. The reaction mixture was left to stand at room temperature for thirty minutes. An UV-visible spectrophotometer was used to measure the absorbance at 725nm after centrifuging the supernatant. On a typical graph, increasing concentrations were displayed. The amount of tannin in the sample was stated as milligrams of tannic acid equivalent per 100grams.

Determination of Total Phenolics
The Folin-Ciocalteau reagent method (Harborne 1973) was use for the estimation of total phenolics of the *Portulaca oleracea* leaf powder. Folin Ciocalteau reagent is a mixture of phospomolybdate and phospotungstate used for the colorimetric assay of phenolic and polyphenolic antioxidants. It functions by calculating the concentration of the chemical under test required to prevent the reagent from oxidizing. Folin-Ciocalteau reagent was used to oxidize the sample dilution, and sodium carbonate was used to neutralize the reaction. Different concentrations of sample of the test sample have been prepared and then 100µL have been taken from each concentration and mixed with 0.5mL of Folin-Ciocalteau reagent (1/10 dilution) and 1.5mL of Na_2CO_3 25 (w/v). The mixture was left to stand at room temperature for fifteen

minutes in the dark. At 765nm, the absorbance of each sample's blue solution was measured. The outcome was given as milligrams of gallic acid equivalent (GAE) per gram of leaf powder dry weight.

Determination of Reducing Sugars

Adopting Harborne (1973) technique, after macerating the 1g sample in 20mL of distilled water, it was filtered. Alkaline copper reagent (1mL) was applied to 1mL of the filtrate. After boiling for five minutes, the mixture was left to cool. After adding 1mL of phospomolybdic acid reagent and 2mL of distilled water, the absorbance was measured at 420 nanometers.

Determination of Glycosides

Using Harborne (1973) technique, 50mL of distilled water was used to macerate the 1g sample before it was filtered. Four milliliters (4mL) of alkaline pirate solution were added to the 1mL of filtrate. After boiling for five minutes, the mixture was let to cool. At 490 nm, the absorbance was measured.

RESULTS AND DISCUSSION

Results

Table 1 showed the qualitative bioactive phytochemical in leaf powder of widely grown *Portulaca oleracea*. It showed that steroids, tannins and glycosides were less abundant in *Portulaca oleracea*, while alkaloids, flavonoids, terpenoids, total phenolics, and reducing sugar steroids were more abundant and saponin was not detected. Table 2 showed the quantitative bioactive phytochemical in the leaf powder. The total phenolic was 359±16.1, while flavonoid was 34.63±0.22 and alkaloid was 131.11±8.5. The sample also contained 80.7±3.29 reducing sugar, 41.79±1.07 terpenoids, 7.89±0.02 glycosides, 5.15±0.46 of tannins, and 2.58±0.02 of steroids. Saponin was not detected in *Portulaca oleracea* leaf powder.

Table 1: Qualitative Bioactive Phytochemical in Leaf Powder of Widely Grown *Portulaca Oleracea*

Phytochemical	Alkaloid	Flavonoid	Steroids	Terpenoids	Tannins	Total phenolics	Reducing sugar	Glycosides	Saponin
Qualitative value	++	++	+	++	+	++	++	+	-

+: Less Abundant, ++: more Abundant

Table 2: Quantitative Bioactive Phytochemical in Leaf Powder of Widely Grown *Portulaca Oleracea* (mg/100g dry Weight)

Phytochemical	Alkaloid	Flavonoid	Steroids	Terpenoids	Tannins	Total phenolic	Glycosides	Saponin
Quantitative value	131.11±8.50	34.63±0.22	2.58±0.02	41.79±1.07	5.15±0.46	359±16.10	7.89±0.02	-

Values are Means±Standard Deviations of Triplicates

Discussion

The qualitative and quantitative bioactive phytochemical in leaf powder of widely grown *Portulaca oleracea* were evaluated, respectively. Qualitatively, the test sample had more abundance of alkaloids, flavonoids, terpenoids, total phenolic and reducing sugars, while quantitatively, total phenolic was highest bioactive phytochemical present while steroids was the least and saponin was undetected. This abundance of bioactive phytochemical forms the hallmark of its potential roles in protecting the body against free radicals and also in protecting the cells against diseases of degeneration and other diet-related non-communicable chronic diseases. Also, the numerous medicinal properties of *Portulaca oleracea*, a widely grown and underutilized crop seen in majority of our localities still confirmed the fact that we have a lot of natural products in our environment which we can explore to combat many emerging and re-emerging infectious diseases (Jesumirhewe *et al.,* 2019) and non-infectious diet related chronic diseases. The qualitative result of the glycosides (+) was the same with the report from Okafor & Ezejindu (2014), while, the steroids (+) found in this vegetable was against the qualitative phytochemical findings of Okafor & Ezejindu (2014). The non-presence of saponin as seen in this report was not the same with the report from Okafor & Ezejindu (2014) and the terpenoids was more abundant (++) than that of purslane extract (+) (2014). The abundance of terpenoids and other phytochemicals as researched could be attributed to the whole concentrated dry leaf powder used in this study instead of extract. *Portulaca oleracea* is a vital nutritional vegetable with huge nutraceutical and pharmacological potential (Aliaa *et al.,* 2019) as evidenced by its richness in numerous phytochemicals. Despite being the eighth most widely distributed plant in the world, people's health can be improved by using it as a significant food and medication (Ajay *et al.,* 2022).

Based on the quantitative bioactive phytochemicals analysed, the data obtained showed that concentrations of alkaloid and total phenolic were the highest bioactive phytochemicals present in the *Portulaca oleracea* leaf powder. The alkaloid in the study (131.11±8.5) was higher than that in *Portulaca oleracea* (26%) (Okafor & Ezejindu 2014), and 3.92^{a}±0.29 (water extract) and 3.97^{a}±0.12 (ethanol extract) (Aliaa *et al.,* 2019) respectively. This could be attributed largely due to the fact that this research made use of the wholesome leaf powder while other authors used the extract which were less in quantitative values of the bioactive phytochemicals analysed. The total phenolic (359.9+16.1) gotten from this study was higher than 0.67^{a}±0.27 (water extract) and 0.69^{a}±0.13 (ethanol extract) (Aliaa *et al.,* 2019). Alkaloids are a significant class of organic chemicals that exist naturally and have a variety of pharmacological and therapeutic uses and qualities, including antidiabetic and hypoglycemic effects (Roozi *et al.,* 2019), antioxidant activities (Yang *et al.,* 2009), anticholinesterase activity (Xiu *et al.,* 2019). Alkaloids equally have anticancer and neuroprotective properties (Ajay *et al.,* 2022). Some of the alkaloids found in *Portulaca oleracea* are oleracein A, oleracein B, oleracein C, oleracein D, oleracein E, oleracein K, oleracein L, scopoletin, aurantiamide, aurantiamide acetate, N-cis-Feruloyloctopamine, N-trans-Feruloyloctopamine, N-cis-Feruloyltyramine, Indole-3-aldehyde, etc. (Roozi *et al.*, 2019; Zhuo *et al.,* 2015). Portulaca oleracea contains phenolic compounds contain a variety of biological actions that include anti-inflammatory, anti-cancer, and anti-atherosclerosis effects on human health (Ajay *et al.,* 2022). There have been reports of several phenolic compounds from Purslane, including gentisic acid, benzoic acid, gallic acid, p-coumaric acid, caffeic acid, and anisic acid (Silva & Carhalho 2014).

The flavonoids (34.63 ± 0.22) gotten from this study was higher than that in fresh purslane leaf extract (1.23^{a}±0.19 for water extraction and 1.26^{a}±0.24 for ethanol extraction method respectively) (Aliaa *et al.,* 2019). Flavonoids play lots of biological roles in humans: anti-oxidative, anti-inflammatory, antitumor, antiviral and antibacterial activities (Cushinie & Lamb 2011). Some of the flavonoids in *Portulaca oleracea* are kaempferol, apigenin, luteolin, myricetin, quercetin, genistein, genistin, isorhamnetin, and naringenin (Nemzer & Al-Taher 2020; Ajay *et al*., 2022; Zhuo *et al.,* 2015). The tannins content (5.15±0.46) of the *Portulaca oleracea* leaf powder was higher than that in purslane ethanol extract (3.15±0.19), purslane water extract (2.65±0.35) (27) and (0.03%) (Okafor & Ezejindu 2014). The different ways by which the study samples were being processed, species or distribution of the plant, seasonality of cultivation and the difference in the maturity rates of the various leaves use in these studies could be the reasons for the differences in the report. Tannins have antiviral, antibacterial and anti-parasitic properties (Kolodziej & Kiderlen 2005). The reducing sugar found in this study was 80.7± 1.9. The numerous benefits attached to the phytochemicals seen in this test sample calls for us to continue to explore the potentials of underutilized crops (Nura *et al.,* 2022) and some crops going into extinction which *Portulaca oleracea* is one of them.

CONCLUSION

Portulaca oleracea leaf powder as shown in this study is rich in bioactive phytochemicals of health importance. These bioactive phytochemicals play numerous roles in cell protection against free radicals thereby helping to prevention diet-related non-chronic diseases and degenerative issues in human. Since *Portulaca oleracea* is underutilized in our localities and beyond, despite its numerous health, the need to create awareness about it becomes essential so that farmers and every lover of vegetables and those who seek for natural ways of promoting good health will start cultivating and using the vegetables in their daily meals.

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