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# Research Article
# Nutritional and Pharmacological Potential of Ethanol Leaves Extract of *Taraxacum officinale*

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## Abstract

**Background and Objective:** *Taraxacum officinale* (dandelion) leaves are used as common vegetable and eaten as salad or cooked in soups and sauces by Nigerians. Several studies revealed that wild or semi-wild plants are nutritionally important because of their high vitamins, minerals, proteins, essential fatty acids and fibre contents. Apart from being nutritious, dandelion leaves are believed to have some medicinal properties like being diuretic, antioxidant, anti-inflammatory, antidiabetic, antimicrobial, anticancer etc. The objective of the study was to determine the nutritional and pharmacological potential of ethanolic leaves extract of *Taraxacum officinale* so as to a mass data to support and encourage its usage in human nutrition and in disease treatment. **Materials and Methods:** Fresh leaves of *Taraxacum officinale* were obtained. The fresh leaves were washed, dried and ground to powdered form and then an extract was formed using ethanol. The extract was used for the various analysis i.e., phytochemical, proximate, elemental analysis as well as antioxidant and antibacterial activity. **Results:** The proximate analysis of *Taraxacum officinale* showed high percentage of crude fiber followed by ash and carbohydrate contents with crude protein having the least percentage. The phytochemical screening revealed the presence of tannins, terpenes and phenolic compounds in the leaves. The mineral elements analyzed using Atomic Absorption Spectrophotometry of the leaves enumerate elements like Mg, Na, K, Ca, Mn, Fe, Zn, Cu, Pb and Cr. The leaves extract possess some degree of antimicrobial activities on *E. coli* and *S. aureus*, while *P. aeruginosa* and *Salmonella typhi* showed no activity. Antioxidant activity was evaluated using the DPPH assay, where the plant leaves extract shows promising antioxidant potentiality. **Conclusion:** The results indicated that, the leaves are potential sources of useful nutrients and could be used to fulfil the growing demands of plant-based food.

Key words: *Taraxacum officinale*, nutritional, pharmacological, phytochemical, antioxidant

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Competing Interest: The authors have declared that no competing interest exists.

Data Availability: All relevant data are within the paper and its supporting information files.

## INTRODUCTION

It is worthwhile to note that leafy vegetables are important valuable sources of nutrients that contributes significantly to protein, minerals, vitamins, fibres and other nutrients which are usually in little amount in daily diets[1]. The consumption of various edible vegetable plants as sources of food could be helpful to nutritionally marginal populace especially in developing countries[2].

There are many names by which indigenous leafy vegetables are recognised by different authors including wild vegetables[3], African leafy vegetables[4] and traditional leafy vegetables[5-6].

Despite the fact that green leafy vegetables clench an important place in well balanced diets, their nutritive values remain underutilized due to lack of awareness and advancement of suitable skills for their effective utilization[7]. Wild vegetables are easy to cook and naturally have a good taste without addition of any spices, cooking oil or food additives[8]. These vegetables are inexpensive nonetheless high quality sources of nutrition especially for low income and marginalized sectors of the economy[9]. WHO recommended a minimum daily intake of 400 g fruits and vegetables[10].

Plant *Taraxacum officinale* commonly known as Dandelion belongs to the family Asteraceae, the latin name *Taraxacum* is from Greek and means "Disease remedy" shown in Fig. 1. It grows to a height of about 12 inches with a creeping root system. The plant has an erect stem with the leaves at the base in a rosette form or alternative position capped by golden yellow flowers[11-13].

*Taraxacum officinale*, is used for medicinal purposes because of its choleretic, diuretic, anti-oxidant, anti-oxidant, anti-inflammatory, anti-diabetic, anti-microbial, anti-cancer and hepatoprotective properties[14-15]. Traditionally *Taraxacum officinale* is commonly used as food. The leaves are used in salad and tea while the roots are often used as coffee substituted. Dandelion leaves and root extracts have been used for hundreds of years to treat liver, gallbladder, kidney and joint problems[16]. In some communities, dandelion is considered a blood purifier and is used as remedy for various ailments such as eczema and cancer. As is the case today, dandelion has been used historically to treat poor digestion, water retention and disease of the liver including hepatitis[17].

Dandelion leaves are used as common vegetable and eaten as salad or cooked in soups and sauces by Nigerians. Over the years, several studies have revealed that wild or semi-wild plants are nutritionally important because of high vitamins, minerals, proteins, essential fatty acids and fibre contents[18-24]. Even though dandelion leaves are used as food, there is paucity of information about their constituents' that make them nutritious and also exhibit their medicinal properties. So, this study explored the nutritional and pharmacological potential of ethanolic leaves extract of *Taraxacum officinale*.

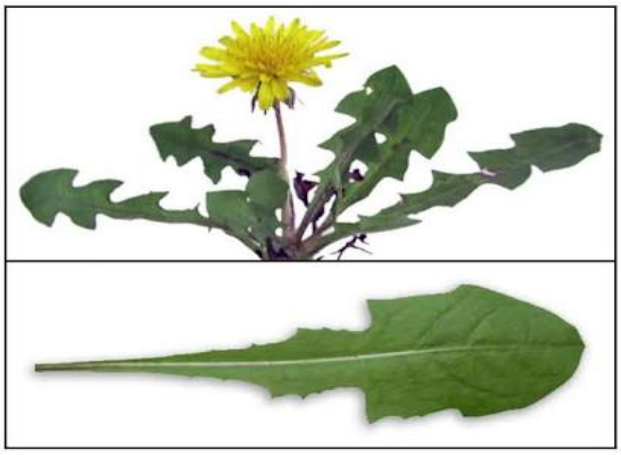

Fig. 1: *Taraxacum officinale* plant

## MATERIALS AND METHODS

**Collection and preparation of plant sample:** Fresh plant leaves of *T. officinale* were obtained from Yankaba market and identified by Malam Baha'uddeen Sa'id a Botanist/Taxonomist at the Department of Plant Biology, Bayero University Kano, where voucher specimen was deposited (BUKHAN 0139).

The fresh plant leaves were washed under running tap water, air dried, ground into a fine powder and stored in an air tight container at room temperature.

About 50 g of pulverized air dried leaves of *Taraxacum officinale* was mixed with 250 mL of ethanol in a closed container and then kept for 48 h. It was then filtered using filter paper and the extract was evaporated to dryness on a water bath and the extract was stored for various analysis.

**Proximate analysis:** Moisture, crude protein, crude fat, total ash and crude fibre contents of the powdered leaves of *T. officinale* were determined using standard methods of the Association of Official Analytical Chemists[25]. Moisture content was determined by heating 2 g of powdered plant material to a constant weight in a crucible placed in an oven maintained at 105 EC. The dry matter was used in the determination of other parameters. Crude protein (Total nitrogen %×6.25) was

determined by the Kjeldahl method, using 2 g of powdered plant material; crude fat was obtained by exhaustively extracting 5 g of powdered plant material in a Soxhlet apparatus using petroleum ether (boiling point range 40-60°C) as the extractant. Ash was determined by incineration of 10 g of powdered plant material placed in a muffle furnace maintained at 550°C for 5 h. Crude fibre was obtained by digesting 2 g of powdered plant material with $H_2SO4$ and NaOH and incinerating the residue in a muffle furnace maintained at 550°C for 5 h. Carbohydrate was determined by difference. Each analysis was carried out in triplicate.

**Phytochemical analysis:** Phytochemical tests on the leaves of *Taraxacum officinale* were carried out on both the crude ethanolic extract and the ground powder using standard procedures as described[26-28].

**Elemental analysis:** Test for the presence of minerals was carried out after acid digestion. The supernatant was decanted and the liquid was analyzed for the levels of Ca, Mg, K, Mn, Na, Cr, Cu, Fe, Zn and Pb using standard procedures. Sodium and potassium were determined using a flame photometer while calcium, magnesium, copper, chromium, zinc, iron and lead levels were analyzed using Atomic Absorption Spectrophotometer. In order to avoid interferences in the determinations, the mixture were made to contain the same acid concentration. To overcome potential interference when determining Ca and Mg, a modifier 1% Lanthanum (w/v) was added to the final sample dilution and/all standards and blank which served as releasing agent. In the determination of Na and K, ionization interferences were dealt with by adding Caesium to both the sample and the standard[29].

**Antioxidant activity:** The free radical scavenging capacity of the extract was determined using 1,1-diphenyl-1-picrylhydrazyl (DPPH) assay[30]. The extract was mixed with ethanol to prepare the stock solution (1 mg $mL^{-1}$). Freshly prepared DPPH solution was taken in a test tube and extracts were added followed by serial dilution to every test tube such that the final volume was 2 mL and discoloration was measured at 517 nm after incubation for 30 min in the dark at ambient temperature. Measurements were performed in triplicate. Ascorbic acid, a well-known antioxidant was used as a reference standard and dissolved in ethanol to bring the stock solution to the same concentration (1 mg $mL^{-1}$). The control sample was prepared, which contain the same volume without any extract and ethanol was used as the blank. The percentage inhibition ratio was calculated according to the following equation:

$$\text{Inhibition (\%)} = \frac{\text{Absorbance of control-Absorbance of sample}}{\text{Absorbance of control}} \times 100$$

All these tests were performed in triplicate and a bar chart was plotted with the mean values.

**Antibacterial activity**

**Test organisms:** The bacterial strains used for evaluation of antibacterial activity were *Staphylococci aureus*, *Pseudomonas aeruginosa*, *Salmonella typhi* and *Eschericia coli* species. Pure bacterial cultures were obtained from the Department of Microbiology, Bayero University Kano, Nigeria. The culture of organisms was sustained on stock culture agar. A loop of culture was inoculated in nutrient broth from the stock culture.

**Preparation of disc:** The extract was diluted using di-methyl sulphoxide (DMSO). About 0.002 g of the extract was added to 1 mL of DMSO and this served as the stock solution. From the stock solution 0.5 mL was taken and placed into another container and labelled 20 µg, 0.5 mL of DMSO was added into the remaining stock solution making 1, 0.5 mL was taken from the stock solution and placed into another bottle and labelled 10 µg, 0.5 mL of DMSO was added to the remaining stock solution again, 0.5 mL was taken and placed into another container and labelled[31] 5 µg.

**Standardization of inoculum:** Few colonies of microbial growth of confirmed isolates to be tested was dispensed in sterile normal saline to match the McFarland standards for sensitivity tests as described by CLSI[32].

***In vitro* screening of antimicrobial activities of the plant leaf extracts:** The agar well diffusion assay method described was used to evaluate the antibacterial activities of the crude extracts of *Taraxacum officinale* against the test micro-organisms. About 20 mL of nutrient agar for bacteria were poured into sterile Petri dishes (90 mm) and allowed to set. Standardized concentrations (McFarland 0.5) of overnight cultures of test isolates were swabbed aseptically on the agar plates and holes (6 mm) were made in the agar plates using a sterile metal cork-borer. The concentration of the various dilutions of the plant extract and control were put in each hole

under aseptic condition, kept at room temperature for 1 h to allow the agents to diffuse into the agar medium and incubated accordingly. Ceftrizone (5 μg $mL^{-1}$) was used as positive controls in the antibacterial evaluations; while DMSO was used as the negative control. The MHA plates were then incubated at 37°C for 24 h. The inhibition zone diameters (IZDs) were measured and recorded.

## RESULTS AND DISCUSSION

The results of the various analyses; proximate, phytochemicals, elemental and antibacterial activity were presented in Table 1-4 accordingly. While the result of the antioxidant activity was presented in Fig. 2.

**Proximate analysis:** The proximate composition of *T. officinale* presented in Table 1 showed crude protein to be 6.89%, total carbohydrate 19.10%, total ash 21.28%, crude fat 9.6%, crude fiber 34.03% and moisture content 9.1%.

The crude protein content (6.89%) obtained in this study was found to be higher when compared to 6.30% in water Spinach and 4.60% in *Momordicafoetida* leaves[33] and found to be lower when compared to 24.85% in sweet potatoes leaves and 27.51% in *Moringa oleifera*[34]. Protein are essential nutrient for human body which are the building block of body tissue and serve as fuel source. Common dandelion contained an appreciably low amount of protein.

This study revealed that the moisture content (9.6%) of dandelion leaves was higher than those of common leafy vegetable such as *Adansonia digitate* (9.0%), but lower compared to 76.53% in *Moringa oleifera* leaves[34]. The moisture content gives an indication of water soluble vitamins present. The total ash content (21.28%) of dandelion leaves which was found to be relatively high gives an indication that the leaf may be a rich source of inorganic mineral elements. The value obtained was higher compared to 1.8% reported in sweet potato leaves[18], 10.83% in water spinach leaves and 18.00% in Balsam apple leaves[35].

The study also revealed that there was a good amount of fiber in the leaves, an indication that it can serve as a good source of fiber which might aid digestion, help reduce serum cholesterol level, risk of coronary heart disease and hypertension[36]. The fiber content of dandelion leaves (19.10%) was higher compared to 7.2% in sweet potatoes leaves and 19.25% in *Moringa oleifera* leaves[34]. The fat content of dandelion leaves was found to be 9.60% which is lower than 11% in water spinach leaves and 12% in *Senna obtusfolia*, but higher when compared to spinach leaves (0.3%), Chaya leaves (0.4%) and 1.60% in *Amaranthus hybridus* leaves[37]. Crude fats are the principle sources of energy. One gram of lipid provides 9.0 kcal (37.33 kJ) of energy[38], which indicates that 100 g of dandelion leaves lipid should provide about 73.89 kcal (306.48 kJ) of energy.

Table 1: Proximate analysis of *T. officinale* leaves powder

| Constituents | Composition (%) |
|---|---|
| Moisture | 9.10±0.44 |
| Ash | 21.28±0.24 |
| Crude fat | 9.60±1.21 |
| Crude protein | 6.89±0.58 |
| Crude fiber | 34.03±0.80 |
| Carbohydrate | 19.10±2.30 |

Values are mean±standard deviation of triplicate determinations

Table 2: Phytochemistry of ethanolic extract of *T. officinale* leaves

| Phytochemical constituents | Results |
|---|---|
| Tannins | + |
| Saponins | - |
| Flavonoids | - |
| Terpenoids | + |
| Glycosides | - |
| Alkaloids | - |
| Phenolic | + |

+: Present. -: Not detected

Table 3: Elemental analysis of *T. officinale* leaves ethanolic extract

| Test elements | Concentration (mg $L^{-1}$) |
|---|---|
| Calcium | 2.00±0.05 |
| Magnesium | 0.63±0.15 |
| Sodium | 61.36±2.36 |
| Potassium | 38.03±0.04 |
| Iron | 1.37±0.07 |
| Copper | 0.18±0.02 |
| Zinc | 0.14±0.03 |
| Manganese | 0.05±8.50 |
| Lead | 0.22±0.05 |
| Chromium | 0.19±0.04 |

Values are Mean±standard deviation of triplicate determinations

Table 4: Antibacterial activity of ethanolic leaf extract of *T. officinale*

| Organisms | 5 mg $mL^{-1}$ | 10 mg $mL^{-1}$ | 20 mg $mL^{-1}$ | Control (ceftrizone) (mm) |
|---|---|---|---|---|
| *E. coli* | 22.00±2.00 | 15.33±4.16 | 12.00±5.29 | 21.00±2.65 |
| *S. aureus* | 12.00±2.00 | 10.67±1.53 | 0.00±0.00 | 16.00±2.00 |
| *P. aeruginosa* | 0.00±0.00 | 0.00±0.00 | 0.00±0.00 | 41.67±12.74 |
| *Salmonella typhi* | 0.00±0.00 | 0.00±0.00 | 0.00±0.00 | 47.67±8.14 |

Values are mean±standard deviation of triplicate determinations

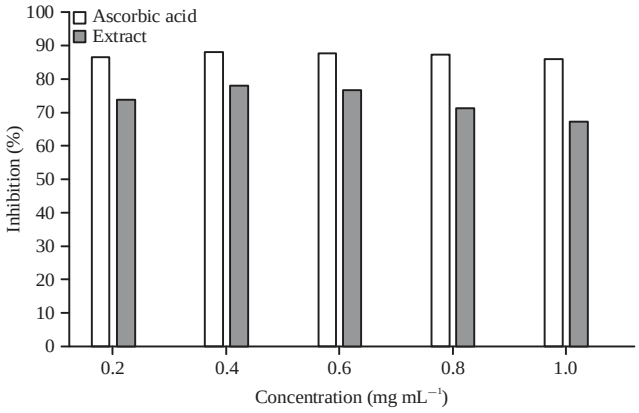


Fig. 2: Antioxidant activity of *T. officinale* leaves compared with other standard antioxidant

The total carbohydrate content of common dandelion leaves was found to be 19.10%. The carbohydrate content of the leaves is considerably low compared to some other leafy vegetables like *Tribulus terrestris* 55.67, 54.20% in water spinach leaves and 75% in sweet potato leaves and 82.8% in *Corchorus tridens* leaves[18]. This relatively low carbohydrate content makes it suitable to be eaten when one wants to lose weight.

**Phytochemical analysis:** Phytochemical screening of *T. officinale* leaves presented in Table 2 revealed the presence of tannins, terpenes and phenolic compounds.

The reported health benefits of *Taraxacum officinale* leaves may be attributed to these phytoconstituents (tannins, terpenes and phenolic compound) that might be of medicinal value; as tannins are plant metabolites well recognized for antimicrobial properties and phenolics retain antioxidant potential that could augment the body's resistance to pathology induced free radical generation[39]. The importance of terpenoids, phenolics and tannins in various antibiotics used in treating common pathogenic strains has recently been reported[40-41].

**Mineral analysis:** The minerals determined in *T. officinale* ethanolic leaves extract were magnesium, sodium, potassium, calcium, manganese, iron, zinc, copper, lead and chromium as presented in Table 3.

Minerals are nutrients needed by the body in small amounts to help it function properly and stay strong. Humans need small amounts of minerals to maintain normal body function and good health, some of which must be supplied by the diet (as essential nutrients).

The potassium content of common dandelion leaves (38.03 mg L$^{-1}$) in this study was higher compared to 6.42 mg L$^{-1}$ found in *Diospyros mespiliformis* and lower compared to 42.74 mg L$^{-1}$ in *Mucuna flagellipes*[42]. The sodium content of common dandelion leaves (61.36 mg L$^{-1}$) was high compared to 5.00 mg L$^{-1}$ reported in *Tribus terrestris* leaves[43], 3.29 mg L$^{-1}$ in *Mucuna flagellipes*[43] and 45 mg L$^{-1}$ in *Senna obtusfolia*[44]. The Na and K are important in our diet due to the role played in muscle contraction, nerves impulses, heart rhythm, digestion, pH balance and blood pressure regulation[45].

The calcium content in the common dandelion leaves (2 mg L$^{-1}$) was low compared with the calcium content of 17.95 mg L$^{-1}$ in *Cassia siamea* leaves[46]. Calcium is needed for growth and maintenance of bone, teeth and muscles. The magnesium content of common dandelion leaves was 0.63 mg L$^{-1}$ which is low compared to 2.56 mg L$^{-1}$ in *Diospyros mespiliformis*[35] and 23.18 mg L$^{-1}$ of *Amaranthus hybridus* leaves[37]. Magnesium content of common dandelion can serve as cofactor for metabolic regulations.

Copper plays a role in haemoglobin formation and it contributes to iron and energy metabolism. The copper content of common dandelion was 0.18 mg L$^{-1}$, which is higher when compared to 0.01 mg L$^{-1}$ in *Diospyros mespiliformis*[35] and lower compared to 1.33 mg L$^{-1}$ in *Mucuna flagellipes*[42] and 0.5 mg L$^{-1}$ in *Cassia siamea* leaves[46]. The zinc content of common dandelion leaves of (0.14 mg L$^{-1}$) was found to be higher compared to 0.10 mg L$^{-1}$ in *T. terrestris* leaves but lower in comparison to 6.85 mg L$^{-1}$ in *Cassia siamea* leaves[46]. The value of zinc obtained for common dandelion leaves implies it's a good source of zinc which can help boost the body immunity and heal wounds. Manganese is another microelement essential for human nutrition. It acts as a cofactor of many enzymes[47]. The manganese content of common dandelion leaves (0.05 mg L$^{-1}$) was lower when compared to 0.3 mg L$^{-1}$ in lettuce and 0.2 mg L$^{-1}$ in cabbage[48].

The iron content of common dandelion leaves (1.37 mg L$^{-1}$) was higher than some cultivated vegetable such as 0.7 mg L$^{-1}$ in lettuce and 0.3 mg L$^{-1}$ in cabbage[48], but lower than 70.0 mg L$^{-1}$ in *Cassia siamae*[47] and 57.08 mg L$^{-1}$ in *Mucuna flagellipes* leaves[43]. The use of common dandelion leaves in our diet could help in boosting the blood level especially in anaemic condition. The lead content of common dandelion is 0.22 mg L$^{-1}$. Diatta *et al.*[49] reported much higher concentration of lead in the leaves of the plant from the area of Poznan which is 1.7-6.2 mg L$^{-1}$. The lead content in

common dandelion cannot be toxic to humans due to its low value in nutrition. The chromium content of common dandelion (0.19 mg $L^{-1}$) which was similar to those reported for dandelion. Chromium is needed in small amount by the body for normal function such as digesting food, which implies that, the low amount of chromium content in common dandelion is useful.

**Antibacterial activity:** The ethanolic extract of *T. officinale* showed inhibition of growth of *S. aureus* and *E. coli*, but no zones of inhibition were shown against *P. auregenosa* and *S. typhi*as presented in Table 4. At concentration 20 mg $mL^{-1}$, the mean diameter of zone of inhibition against *E. coli* were 12.00±5.29 mm. Also at concentration 10 mg $mL^{-1}$, the mean diameter of zone of inhibition against *E. coli* was 15.33±4.16 mm and that of *S. aureus* was 10.67±2.65 mm. At concentration 5 mg $mL^{-1}$, the ethanol leaf extract showed zone of inhibition against *E. coli* with mean diameter of 22.00±2.00 mm and against *S. aureus* with mean diameter of 12.00±2.00.

The extracts showed varied degree of antibacterial activity against the organisms used. The extent of growth inhibition was concentration dependent. The presence of different phytochemical constituents in the leaf extract is offering the therapeutic basis for the antibacterial activities observed in these extracts.

**Antioxidant activity:** Comparison of the antioxidant activity of the extract and standard ascorbic acid was shown in Fig. 2. Antioxidant activity decreased with decreasing extract concentrations (0.2-1.0) of the samples which increased at the beginning and gradually reduced at higher concentrations.

Antioxidant activity assay in this study, the ethanol extracts of *Taraxacum officinale* leaves was investigated using the DPPH scavenging assay by determining the total antioxidant capacity of the extract. All these have proven the effectiveness of the dandelion leaves compared with the reference standard antioxidant ascorbic acid. The DPPH antioxidant assay is based on the ability of DPPH, a stable free radical to decolorize in the presence of antioxidants. The DPPH contains an odd electron that is responsible for the absorbance at 517 nm and also for the visible deep purple color. When DPPH accepts an electron donated by an antioxidant compound, the DPPH is decolorized, which can be quantitatively measured from the changes in absorbance.

## CONCLUSION

The results of the study indicated that, the leaves of *Taraxacum officinale* are potential sources of valuable nutrients which could be used to fulfil the growing demands of plant-based food.

## SIGNIFICANCE STATEMENT

This study discovers that the leaves of common dandelion contain appreciable amount of macro-nutrients and micro-nutrients and certain phytochemicals which may account for its reported medicinal benefits, suggesting that their prudent consumption would contribute prominently towards meeting human nutritional requirements for normal growth and pharmacological benefits.

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