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Quantitative Investigation Of Total Phenolics Content In Spray-Dried Dandelion Extract Powder

Thandar Aung[1] , Sreemoy Kanti Das[2]
[1,2]Faculty of Pharmacy, Lincoln University College, Selangor, Malaysia
Corresponding author's E-mail: sreemoy@lincoln.edu.my

ABSTRACT
With the knowledge that it includes phenolic compounds with antioxidant properties, the herb dandelion (*Taraxacum officinale*) may benefit health. The total phenolic content of powdered dandelion leaf and root extract produced by spray drying was examined in this work. A UV-Spectrophometric method alongside Folin Ciocalteau reagent, with gallic acid as standard, was used to determine the total phenolic content of powdered dandelion leaf and a dandelion root extract. The results given that the root extract had 9.07 ± 0.54 mg GAE/g as well as the leaf extract showed 32.54 ± 0.49 mg GAE/g. The dried leaf powder measured 9.82 ± 0.11 mg GAE/g, while the dried root powder measured 2.34 ± 0.14 mg GAE/g, in comparison to the dried leaf and root powder. When comparing spray-dried dandelion leaf and root extract powder to traditional dried powders reveals significant variations in phenolic content. Besides, the previously reported hydro-ethanol extraction method was contrasted with the recently investigated hydro-decoction extraction method. Comparing the ethanol extraction method, our hydro-decoction extraction greatly increased the phenolic abundance. The significant amount of phenol in the spray-dried extract indicates that it has the potential to become a widely used antioxidant with a variety of uses.

In conclusion, this work clarified the total phenolic content of powdered dandelion leaf and root extract obtained using a hydro-decoction extraction method followed by spray-drying, pointing out notable variations in phenolic content before and after spray-drying. Further investigation are needed to explore the potential health benefits of dandelion extract and their activity in disease prevention and treatment.
Key words: *Dandelion; Phenolic; Taraxacum; Spray-dried extract, Antioxidant*

INTRODUCTION

The medicine produced by plants have been used for a variety of goals all through historical events, with therapeutic uses being one of the most common. Herbal medicines are compounds that come from herbs and have a lot of medicinal benefits. The aforementioned alternatives, which are frequently used as supplementation for both the prevention and treatment of various kinds of ailments, can comprise unfiltered or processed constituents coming from one or more plants. Ayurveda and traditional medicine are two examples of the many medical systems that have such actions ingrained in them. Because of its cultural acceptability, compatibility with the human body, safety, cost-effectiveness, availability, and the comparatively lower level of negative impacts concerning organic products as opposed to synthetic medicines, traditional medicine continues to be a vital component of health services in numerous nations [2].

The adoption of conventional drugs is advised by the World Health Organization (WHO), which emphasizes that their reliability and efficiency need to be confirmed by science [3]. It is significant that over 25% of medications on the market come directly or indirectly from plants [4]. Both the importance of plants in contemporary medicine and the need for more research into their healing properties are highlighted.

Recently, interest has emerged in the healing potential of widely-available plant extracts. Interest in the potential health benefits of dandelion (*Taraxacum Officinale*) has emerged due to its high levels of phenolic compounds, well-known for the strong antioxidant properties [5]. The bright yellow flowers and serrated leaves of the dandelion make this potent, ubiquitous plant easily recognizable all over the globe. It is known for its resistance to various environments and may be in the Asteraceae family [6]. As plants that prefer water drainage and sun, dandelions are hardy plants that usually populate grass, glades, and messy spaces. Their powerful taproot structure allows them not only to resist and spread in a remote area, which may explain their global dispersion [7].

Dandelion is also traditionally employed in pharmaceuticals because of its numerous beneficial properties [8] such as diuretic, choleretic, purgative and hepatoprotective effects [10], as well as, anti-inflammatory, antioxidant, and anticancer activities [9]. This study primarily aims to quantitatively investigate phenolic compound content in powder evaluation of dandelion leaf and root extract obtained from one of the best-known spray-drying techniques. Spray drying [11] is a more popular method for the transformation of fluid concentrates into powder to enhance the shelf life of the extract. By providing in-depth quantitative information on phenolic compounds present in the powder obtained in this way, this study aims to provide valuable insight into the potential pharmacotherapeutic applications of dandelion leaf and root extracts.

The results of these studies might help with the creation of medicines and healthy foods that leverage dandelion's beneficial health effects. Especially, the antioxidant properties of dandelion are particularly important in expansion, which can neutralize free radicals, protect cells from damage, and reduce the risk of incurable diseases [12]. Flavonoids and phenolic acids, which are phenolic compounds that occur in dandelion, are also known for their potent antioxidant properties. A core role for reducing chronic oxidative stress, associated with several diseases including cancer, cardiovascular diseases, and neurological disorders [13]. The dandelion has all qualities of a true restorative herb, as confirmed by this study.

This study validates the potential of the dandelion as an important restorative herb. An interesting area of research is the analysis of dandelion's total phenolic content and potential health benefits. We will look at the components and mechanisms of action of dandelions to better utilize their therapeutic benefits. By promoting a thorough factual analysis of the powder, this attempt aims to promote the use of dandelion leaf and root extract powder in the development of innovative homegrown remedies and medications.

MATERIALS AND METHODS

Collection and Preparation of Plant Materials

In this study, the dandelion (Taraxacum Officinale) plants and their roots were gathered from Shan State, in Eastern Myanmar. The subject's ideal growing conditions, which support the development of dominant dandelion plants, led to its selection. After being gathered, the roots and the takeoff were meticulously cleaned to ensure they were free of any contaminants, dirt, or debris. By using a cleansing technique, the plant fiber was guaranteed to be free of impurities that could lower the quality and precision of the final product.

After cleaning, the plant ingredients encountered two processes of drying. They were then permitted to naturally air dry in order to lower the moisture levels step by step and to preserve the effectiveness of the phytochemicals. This natural drying process was then performed in a well-ventilated place away from direct sunlight to prevent deterioration of natural compounds. The semi-dried leaves and roots were then dried in a hot air oven at 60 °C for regulated temperature. Because this process ensured complete drying, the substance found in plants became brittle and easy to ground into a fine powder. A constant temperature was used to maintain the integrity of the phytochemicals of the dandelion.

The leaves and roots were ground into a fine powder by employing a grinder when they had sufficiently dried. A consistent size of particle, precisely 100 mesh size, or around 150 micrometers, was attained by carefully regulating the grinding operation.

Extraction Procedure

In an attempt to extract the phenolic components from the dandelion leaves, Bitwell et al.'s decoction procedure was used [14]. After precisely weighing a 20-gram of the dried leaves that had been finely milled, it was moved to an extraction vessel. A solvent that was entirely free of disrupting minerals was ensured by adding 500 mL of demineralized water to the making solution. Later, the combined product was heated to 100 °C and kept there for half an hour.

This decoction technique breaks away the outer layers of plant cells, allowing phenolic compounds to be released directly into the water. Demineralized water is essential because it prevents unnecessary particles from being present, which could reduce the viability of extraction. After the decoction, it was filtered using a 200 mesh filter. A clear extract containing phytochemicals was delivered once the filtration made any doubt that all strong particles were dispensed with.

Spray Drying

As a result, the filtered extract was sprayed to spray dryer, which is widely recognized for its effectiveness in converting fluid extracts into uniform powder shapes. The operating temperature of the shower dryer was set to 180 °C. The heated air quickly dried the fluid extract, atomizing it into a thin fog, creating powder particles in the spray drying nozzle. This approach increases the extract's shelf life and availability while guaranteeing its organically dynamic constituents. After undergoing additional research recently, the spray-dried powder was gathered in a dry and cleaned container to prevent illness.

Extraction of Dandelion Roots

The procedure used for acquiring the dandelion roots was the same as that used to extract the leaves. A 20 g of the dried root powder was used and the same decoction and spray drying procedures were done. This consistency in the extraction methodology ensured that the results from both the leaves and roots could be reliably compared.

Total Phenolic Content Analysis

The Total Phenolic Content (TPC) quantitative determination of dandelion leaf and root extracts was carried out using the methodology outlined by Khan et al. [15].

Standards and Samples preparation for testing

A standard solution of gallic acid was set up by 10 mg of gallic acid dissolved in 100 mL of methanol to become stock solution, the concentration of 100 μg/mL. The different concentrations (0.08, 0.16, 0.312, 0.625, 1.25, and 2.5 μg/mL) were prepared from the stock solution which varying concentrations were used to plot a standard curve that was necessary for quantifying the phenolic content of dandelion. Dandelion leaf and root extracted powder were prepared 1mg/mL concentration in methanol at the same time. Methanol was used as the solvent for its efficiency in dissolving the phenolic compounds. All the solutions were prepared freshly before analyzing to make sure accuracy, precise and reproducible.

Folin-Ciocalteu Assay

To determine the total phenolic content, the Folin-Ciocalteu reagent method was used. The color changes reaction occurred by phenolic compounds under the alkaline condition which can be measured using a UV spectrophotometer. 2.5 mL of 10% Folin-Ciocalteu reagent was added to 0.5 mL of prepared sample solutions (gallic acid standards and dandelion powder). Then 2 mL of 7.5% sodium carbonate (Na_2CO_3) solution was added to the mixture. The sodium bicarbonate accelerates the reduction process of Folin-Ciocalteu reagents and phenolic compound complex by creating an alkaline environment. The solutions were mixed thoroughly and incubated at room temperature for 30 minutes.

After taking the time for the incubation, the absorbance of each solution was measured by a UV-spectrophotometer (Model UV-1800, Shimadzu) at 760 nm. All of the samples were measured three times to guarantee precision and the authenticity of the measurements of absorbance. The values for absorbance derived from the gallic acid standards fluid were used to build the calibration curve. The assay's correctness was confirmed by the regression equation, which showed a strong linear connection between absorbance and concentration ($y = 0.1968x + 0.1059$ $R^2 = 0.9981$). The regression equation was used to calculate the absorbance values of the dandelion leaf and root extracts for the purpose of measuring the phenolic concentration, which was then expressed in gallic acid equivalents (GAE). The dandelion herbal extracts' antioxidant capability was revealed by the measured phenolic content in its entirety. Stronger antioxidant qualities are generally correlated to enhanced phenolic content, which is advantageous for healthcare [16].

RESULTS AND DISCUSSION

The gallic acid standard was used to quantify both the antioxidant capacity and all phenolic compounds in terms of gallic acid equivalents (GAE). Table 1 illustrates the absorbance values of gallic acid solutions that were examined at various levels of concentration. These figures were employed to generate the absorbance value against the gallic acid concentration in order to visualize the calibration curve. Figure 1 depicts its consequence graph, which illustrates the linear relationship. Table 2 displays the total phenolic content of the powdered dandelion leaf and root that was obtained using hydro decoction and spray-drying methods. According to these findings, the total phenolic content of the leaf extracts was 32.54 ± 0.49 mg GAE/g, which had considerably greater than that of the root extracts, which had a total phenolic content of 9.07 ± 0.54 mg GAE/g. These results emphasize high total phenolic content of dandelion leaves extracted powder related to the roots extracted powder.

Comparison with spray-dried extract powders and conventional dried powders

Significant alterations were seen when the total phenolic content of the spray-dried extract materials was contrasted with that of the same dried leaf and root powders. The phenolic component of the corresponding spray-dried extract powders was observed to be significantly different from the dried leaf and root powders. The amount of phenolic material in the leaf extract powder was noticeably higher (32.54 ± 0.49 mg GAE/g) than in the dry leaf powder (9.82 ± 0.11 mg GAE/g). The phenolic content in the root extract powder was 9.07 ± 0.54 mg GAE/g, while the total phenolic content in the dried root powder was 2.34 ± 0.14 mg GAE/g. See Table 3 for these findings. The entire amount of phenolic content in the dried powders and extracted powders is summarized in Figure 2.

This extraction method's effectiveness is demonstrated by the significant increase in total phenolic content when compared to spray-dried extracts and dried powders. Spray-drying reduces the extracts' concentration of moisture and concentrates their phenolic components, increasing their consistency and shelf life. Moreover, that process enhances the extracts' viability for long-term preservation and a variety of uses by lowering microbial contamination [17]. There are notable variations in the total phenolic content among the leaf and root extracts. The phenolic content of the herbal extracts was higher than that of the root extracts. The actual variation in the phenolic composition of the plant's different portions can help to resolve the variances. Leaves have more phenolic chemicals than roots, which mainly offer keeping while encouraging for the organ systems because leaves are the main component of photosynthesis and metabolizing processes.

Dandelion's therapeutic application is significantly impacted by the investigation of this experiment. The leaf extracts' more effective antioxidants were correlated with their higher phenolic content, making them better suited for use in treatments meant to counteract oxidative stress and associated disorders [18]. The root extracts, however, may have a reduced phenolic content and provide additional areas of interest [19]. The comparison of dried powders and spray-dried extracts demonstrated the importance of the extraction process in concentrating and isolating the active ingredients in beneficial plants. Spray-drying effectively increases the bioavailability and solubility of the phenolic components, which makes the extricates popular for restorative applications.

Comparison with previous studies

Some of the findings from our study were compared to those of Dedić et al. (2022), who used a water-ethanol extraction method to produce total phenolic substance values of 4.23 mg GAE/g for root extract and 30.5 mg GAE/g. The average phenolic substance values for the extracted leaves and roots were 32.54 ± 0.49 mg GAE/g and 9.07 ± 0.54 mg GAE/g, respectively. This indicates that the hydro-decoction process, followed by spray drying, produced a superior phenolic substance and an improved extraction adequacy. When compared to Dedić et al. [20], our work's slight increase in TPC of leaf extracts suggests that the hydro-decoction method may be somewhat better at extracting phenolic compounds from dandelion leaves.

A critical progression in the preparation of emptying phenolic chemicals from the roots was demonstrated by the fact that the total amount of phenolic substance in the root extract from our inquiry was more than twice as high as earlier studies. This illustrates how the hydro-decoction handle, which is applied after drying by spray drying extraction, works very effectively with dandelion roots. The higher phenolic content in the tests we analyzed is taken into consideration by the extraction process. Plant cell dividers are effectively broken down using an extensive bubbling technique known as hydro-decoction, which enables a more complete elimination of bioactive compounds [21]. The water-ethanol extraction method developed by Dedić et al. [20] seems to be less successful than this one. The induction of hot water into the hydro-decoction process is probably helping to advance the extraction of the phenolic compounds, increasing the overall phenolic concentrations.

Given the potential use of dandelion extracts in pharmaceutical and therapeutic goods, this finding is especially significant. These items derived from such extracts may offer more beneficial health effects due to greater quantities of the therapeutic ingredients. The concentration and stabilization of the phenolic compounds are further enhanced by applying the technique of spray drying as a phase that follows hydro-decoction.

More powerful antioxidant qualities are indicated by higher total phenolic compound quantities, which may help prevent and treat oxidative stress-related illnesses. The excessive phenolic content of the leaf extracts makes them especially attractive for consumption as antioxidant treatments. When retrieved via hydro-decoction, the root extracts exhibit a notable rise in TPC while having a lower phenolic concentration than the leaves. It also means that root extracts might be useful in therapeutic uses as well, perhaps providing distinct or supplementary advantages over leaf extracts.

CONCLUSION

The entire phenolic content of spray-dried powdered dandelion was quantitatively examined as part of the proposed study. Ultimately, using root powder and spray-dried extracted powder, we were able to distinguish the complete phenolic content of the dried leaf. Moreover, in contrast to earlier research on the use of water-ethanol extraction techniques, our findings demonstrated the next hydro-decoction viability for extraction. The hydro-decoction method combined with shower drying produced a significant increase in phenolic substance values for both leaf and root extracts. This shows how several extraction techniques that exploit the antioxidant properties of dandelion for medicinal and healing purposes are guaranteed. The phenolic substance's comprehensive analysis revealed crucial information about the effectiveness of the extraction process. Since they have higher concentrations of phenolic components, the spray-dried extracts appear to have improved bioavailability and power, making them attractive options for the development of domestically produced items and supplements. Depending on a comparison of dried leaf and root powders with their corresponding spray-dried extract powder, the amount of material for phenolic compounds obtained by carrying out splash drying was significantly larger than that of the traditional method. Study outcomes demonstrated the effectiveness of the spray drying process in removing and concentrating phenolic compounds from dandelion roots and removing them, hence increasing their antioxidant ability. For the purposes to create contemporary treatments, it may be necessary to investigate the bioavailability and organic movement of these phenolic-rich extracts. In summary, this analysis highlights the importance of extraction techniques in maximizing the phenolic content and bioactive potential of dandelion extracts for a variety of healing and healthful uses.

Table 1. Absorbance of Gallic acid.

No.	1	2	3	4	5	6
Concentration (μg/mL)	0.08	0.16	0.312	0.625	1.25	2.5
Absorbance at 760 nm	0.122	0.126	0.176	0.237	0.345	0.599

Figure 1. Standard Curve of Gallic Acid.

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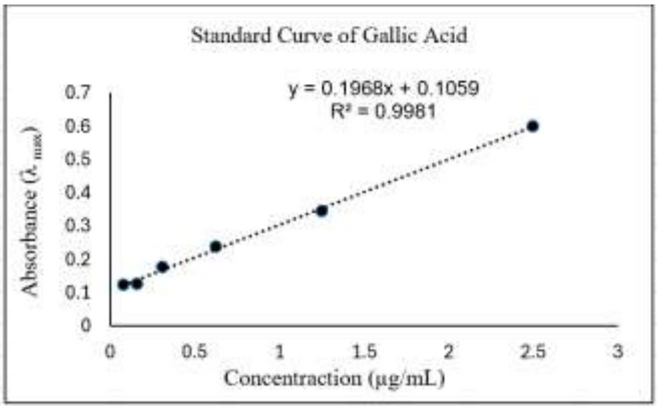

Table 2. Total Phenolic Contents of Dandelion Spray-Dried Extract Powder

No.	Spray dried Extract powder	Absorbance	Phenolic contents (μg/mL) with standard deviation	Phenolic contents (mg.GAE/g) with standard deviation
1	Leaf	0.705	3.28 ± 0.05	32.54 ± 0.49
		0.725		
		0.719		
2	Root	0.261	0.91 ± 0.06	9.07 ± 0.54
		0.281		
		0.276		

Table 3. Total Phenolic Contents of Dandelion Dried Leaf and Root Powder

No.	Dried powder	Absorbance	Phenolic contents (μg/mL) with standard deviation	Phenolic contents (mg.GAE/g) with standard deviation
1	Leaf	0.292	1.02 ± 0.01	9.82 ± 0.11
		0.294		
		0.290		
2	Root	0.261	0.23 ± 0.01	2.34 ± 0.14
		0.281		
		0.276		

Figure 2. Total phenolic contents of extract powder vs dried powder (mg GAE/g)

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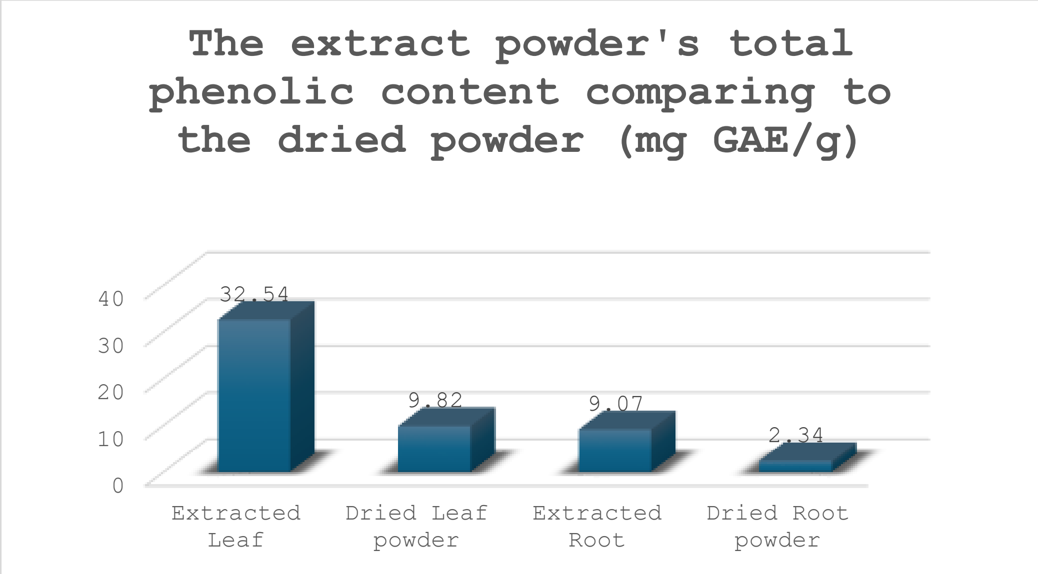

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