Study on Botanical Characters and Preliminary Chemical Composition of Dandelion Leaves *Taraxacum officinale* F.H. Wigg.

Myat Kay Thwe Lwin[1]

Abstract

Common name of Dandelion plant belong to the family Asteraceae is scientifically known as *Taraxacum officinale* F.H. Wigg. Myanmar terms locally known as Dudali/Lion tooth. In this paper presentation, Dandelion plant was collected from FAME Organic Pharming Project, Pyin-Oo-Lwin, during 2017-2018. The cultivation studies of this plants area and the fresh vegetative and reproductive parts of the plant were used in studying morphological characters and the preparation and studying microscopical characters of fresh leaves specimen and dry leaves powdered have been described. The chemical studies, preliminary examination of phytochemical tests were alkaloid, glycoside, reducing sugar, α-amino acid, saponin, flavonoid, phenolic compound, carbohydrate, starch, cyanogenic glycoside and tannin from powdered leaves extracts; physico-chemical tests of pH value, total ash, moisture content, water soluble and ethanol soluble matters; nutritional values tests of protein, fat, fiber and carbohydrates; safety tests of arsenic and aflatoxin; checking for TLC chromatogram of polyphenols from powdered leaves for a role in alternative medicinal value were also presented.

Key words: morphological and microscopical characters, diagnostic characters, phytochemical test, physico-chemical test, safety test

Introduction

The name of the genus, *Taraxacum*, is derived from the Greek *taraxos* (disorder), and *akos* (remedy), on account of the curative action of the plant (Grieve, 1995). The specific name *officinale* means “of the shops” and alludes to this useful plants value as a cash crop (Gamble, 2015). The common name derives from the French '*dent de lion*', meaning 'lion's tooth', which refers to the deeply toothed (Mabey, 1996).

Taraxacum officinale F.H. Wigg. belongs to the family Asteraceae. According to International Plant Names Index (2015), these plants are grown in the temperate regions of the world, especially Europe, Asia and throughout the Northern Hemisphere. Most commercial dandelion is cultivated in Bulgaria, Hungary, Poland, Romania and the United Kingdom (Herbal Resource, 2017 and Wikipedia, 2017).

Dandelion plant cultivation, both from wind blown seeds and seed germination from the seed bank. One dandelion plant can produce over 20,000 seeds. Therefore, it’s best to control them with a systematic approach in an out-of-crop cultivation (Wikipedia, 2017).

Dandelion plant, grows from generally unbranched taproots and produces one to more than ten stems. The stems are upright or lax, and produce inflorescences heads that are held as tall as or taller than the foliage. The leaves have petioles that are either unwinged or narrowly winged. Plants have milky latex and the leaves are all basal. The yellow flowers are ligulate and bisexual. The fruits, called cypselae, range in color from olive-green or olive-brown to straw-colored to graywish, they are oblanceoloid in shape with slender beaks (Hooker, 1882 and Wikipedia, 2017).

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Dandelion leaves contains flavonoids including luteolin, apigenin, caffeic acid, and chlorogenic acid; substantial levels of vitamins A, C, D and B complex; nutritional contains a bitter principle, tannin, insulin, polysaccharides and carotene. Therefore, dandelion leaves are characterized so far and of the studies supporting its use as a medicinal and culinary plant (Herbal Resource, 2017 and Wikipedia, 2017).

Materials and Methods

1. Botanical studies

Collection, classification and identification of *Taraxacum officinale* (Dandelion plant)

Today, the first cultivation of dandelion plant introduce to FAME Organic Pharming Project, Pyin-Oo-Lwin, more improved in quality and safety. To get the specimens were collected from FAME Organic Pharming Project, Pyin-Oo-Lwin, during the flowering and fruiting period time (2017-2018). After collection, these plants were carried out in the Department of Botany, Hinthada University, to get correct family, genus and species with the help of reference literaturers such as Hooker (1882), Dassanayake (1980), Backer (1965) & Wikipedia, (2017). Herbarium specimens were also prepared and kept in the Botany Department, Hinthada University.

Sample preparation and examination of *Taraxacum officinale* (Dandelion leaves)

The collected fresh leaves samples were washed with water to remove impurities. After washing, the fresh leaves specimens were examined by preparing freehand section and examined under microscope. Temporary mounts were prepared with glycerin (Trease and Evans, 1978 & Metcalfe and Chalk, 1950). And then, air dried method for at room temperature to four weeks. The prepared dry powdered leaves was stored in air tight container or desiccators to prevention of moisture and contamination for further uses. Diagnostic characters of powdered leaves were examined by sensory and under microscope to get standardization for health supplements (Venema, 2013, Trease and Evans, 1978 & Metcalfe and Chalk, 1950). These test preparation and examination will be conducted at the Botany Department, Hinthada University.

2. Chemical studies

Qualitative investigation on *Taraxacum officinale* (Dandelion powdered leaves)

In this study, the preliminary phytochemical investigation of the water and ethanol powdered leaves extracts have been carried out to known the presence or absence. The methods of British Pharmacopoeia (1968), Trease and Evans (1978), World Health Organization (2011) were applied for investigation of phytochemical studies. These tests were conducted at the Botany Department, Hinthada University and FAME Pharmaceutical Laboratory, Yangon.

Quantitative investigation on *Taraxacum officinale* (Dandelion powdered leaves)

Physico-chemical properties including pH value, total ash, moisture contents, water soluble and ethanol soluble matters of powdered leaves samples were carried out as in British Pharmacopoeia (1968) and W.H.O (2011). These tests were conducted at the Botany Department, Hinthada University and FAME Pharmaceutical Laboratory, Yangon.

Nutritional value investigation on *Taraxacum officinale* (Dandelion powdered leaves)

The nutritional values such as protein, fat, fiber and carbohydrates were also determined. The protein and fiber were also defined by acid alkali treatment. The fat

content was determined by the soxhlet extraction method. The carbohydrates content was determined by the totally result of protein, fat, fiber, moisture and ash contents. The methods of Horwitz (2000), Kjeldahl (1883), Kirk & Sawyer (1991) were applied for investigation of nutritional value studies. These tests were conducted at the Small Scale Industries Department, Yangon.

Safety test for *Taraxacum officinale* (Dandelion powdered leaves)

Safety tests of arsenic and aflatoxin for dandelion powdered leaves sample by using test kit and ELISA method (Leszczynska, *et al*., 1998). These tests were conducted at the Small Scale Industries Department, Yangon and Nay-Pyi-Taw.

Determination by Thin Layer Chromatography (TLC) for *Taraxacum officinale* (Dandelion powdered leaves)

Thin layer chromatography (TLC) plate was used as 0.25 mm percolated silica gel (GF_{245}, Merck). It was cut into small plate (1x 4 cm size). TLC parameters for polyphenols (flavonoids and polyphenolcarboxilic acid) (Popescu, *et al*. (2010)). These tests were conducted at the FAME Pharmaceutical Laboratory, Yangon.

Results

1. Botanical studies

1.1 Scientific classification

Rank		Scientific Name
Kingdom	:	Plantae
Division	:	Angiosperms
Class	:	Eudicots
Sub-class	:	Asterids
Order	:	Asterales
Family	:	Asteraceae
Genus	:	*Taraxacum*
Species	:	*officinale*
Binomial Name	:	*Taraxacum officinale* F.H.Wigg. -- Prim. Fl. Holsat. 56. 1780 [29 Mar 1780] (According to I P N I, 2015)

1.2 Morphological characters of *Taraxacum officinale* F.H.Wigg. (Dandelion plant)

This plant is a **perennial**, herbaceous plants, can grow as high as about 25 - 45 cm; live for at least three seasons, after an initial period they produce florets (flowers) once a year. **Root system** is a large central tap root system, leaves and stems grow from a taproot; root type grows vertically down, tapering at the end forming a center where secondary roots sprout laterally; fleshy and brittle roots are filled with a white milky substance that is bitter and slightly odorous; dark brown roots may reach into the soil for a foot or more. **Modified stems** (peduncle) are hollow, about 5 - 50 cm long, consisting of a milky sap; stems don't branch off - each stem solely holds one inflorescence head; stems can be tinted purplish over with short hairs, they are upright and held as tall or taller than the foliage. **Modified leaves** are Dent-de-Lion (Lions Tooth) resemble the jagged edged leaves that taper at the tip, usually lay flat to the ground and are formed in a circular arrangement (rosette), about 5 - 25 cm long; petioles are either unwinged or narrowly winged. **Inflorescence** is a terminal head, solitary, about 150 to 200 yellow ray florets (flowers) only, florets open with the sun in the morning and close in the evening or during gloomy weather; involucral bracts 2-seriate, oval to linear-lanceolate, numerous bracts, over with pubescent, greenish colour with the tips dark gray or purplish colour; receptacles small, flat, white, about

1.0 - 1.5 mm across. **Modified Ray florets** are bisexual present, about 2 cm long; white pappus (modified calyx) present, numerous, about 1 cm long, thin and slender shape, persistent; yellow corolla, about 1 cm long, ligulae shape, 5-dentate at the apex, caducous. **Androecium** is the 5 - stamens, about 1 mm long; white filaments are thin and slender, about 0.5 mm long; yellow anthers are lanceolate, about 0.5 mm long, dithecous with pollens numerous; anther aggregate ring into the style tube but filaments are distinct above the point attach to the corolla tube. **Gynaecium** is an inferior; ovary oblong, about 1 mm long, one ovule in each locule, white; basal placentation; pale yellow styles are slender, about 2 cm long; stigma-arms linear bifid, about 3.0 - 6.0 mm long, yellow colour. **Achene** is a modified fruit, oblong, about 1 mm long and 0.5 - 1.0 mm width, yellowish-brown, 5-angled, straight tapering to a truncate base, compressed laterally, woody, dull with small overlapping flat spines at the top of the achene; seeds white, obovoid, about 0.5 mm long. Modified stalk is called a beak, between the persistent calyx (pappus) and the achene, which elongates as the fruit matures. The beak breaks off from the achene quite easily. The morphological characters were shown in figures 1 to 8.

Fig. (1) Habit (The Whole Plant)

Fig. (2) Tap root system

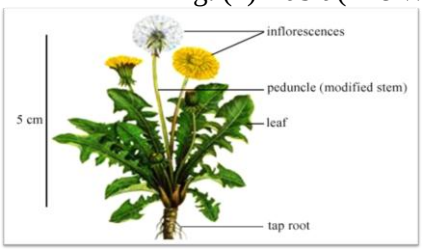


Fig. (3) Root, stem, leaves and inflorescence

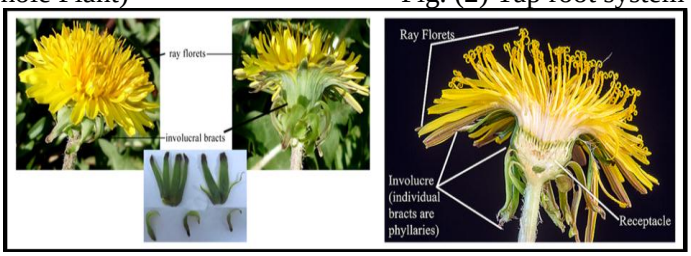


Fig. (4) Inflorescence arrangement

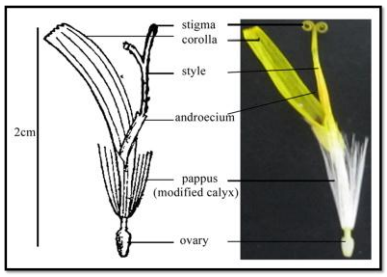


Fig. (5) Ray floret (flower)

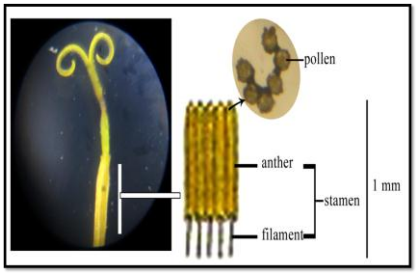


Fig. (6) Androecium members

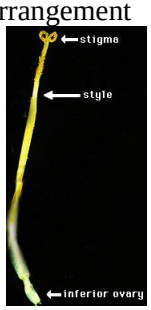


Fig. (7) Gynaecium members

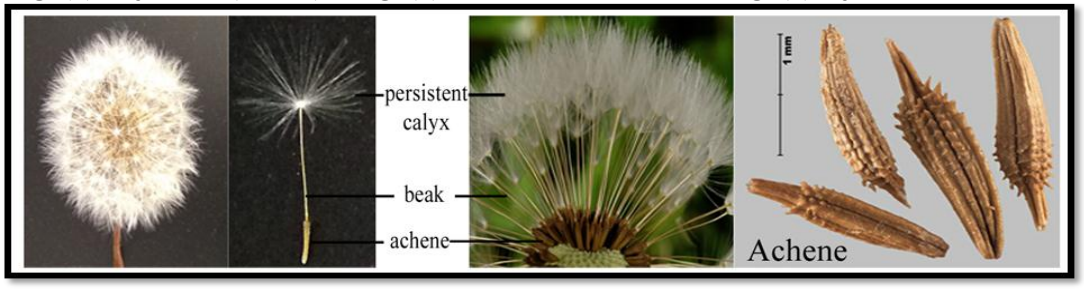
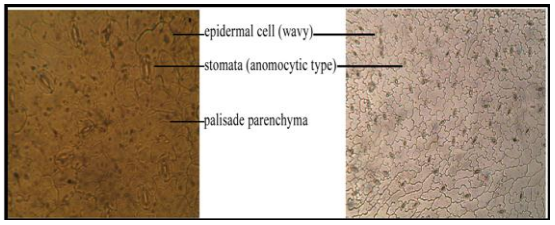


Fig. (8) Achene members

1.3 Microscopical characters of *Taraxacum officinale* F.H.Wigg. (Dandelion leaves)

Lamina

In surface view, the epidermal cells of both surfaces were parenchymatous and thin-walled. The anticlinal walls of the upper and lower surfaces were wavy, stomata were present on both surfaces, usually more present on lower surface. They were anomocytic types. The guard cells were reniform in shape and contain abundant chloroplasts. The oils present in the subsidiary cells. In transverse section, the cuticle layer was thick on both epidermises. Both epidermal cells were barrel to rectangular in shape. The mesophyll consisted of palisade and spongy parenchyma. The palisade mesophyll was made up of two layers of vertically elongated cylindrical cells, they contained numerous chloroplasts and oil cells. The spongy mesophyll consisted of 3 - 5 layers of cells, which were irregular to isodiametric in shape and loosely arranged. The distribution of mesophyll cells near the margin was similar to other parts of the lamina except that no vascular elements were observed and the cells were slightly smaller. They were shown in figures 9 - 10.



X 400 Upper surface Lower surface X 100

Fig. (9) Surface view of lamina

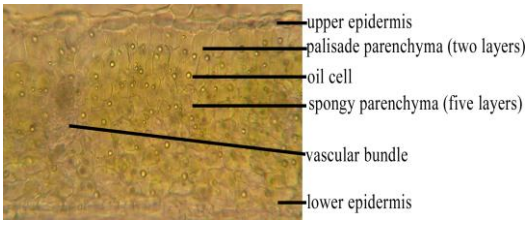


Fig. (10) T. S of lamina X 100

Midrib

In surface view, the epidermal cells of both surfaces were parenchymatous and elongated along the length of the midrib and rectangular in shape. Stomata were present on both surfaces. The midrib in transverse section was slightly convex in the upper surface and moderately concave in the lower surface. The cuticle layers of the both surfaces were thickness. The cortex was made up of lamella collenchyma and thin-walled parenchymatous cells. The collenchyma cells were 2 to 4 layers in thickness towards the upper surface and 3 to 6 layers in thickness towards the lower surface. They were rounded to isodiametric in shape. The parenchyma cells were 4 to 7 layers in thickness above the sclerenchyma and 5 to 11 layers in thickness below the sclerenchyma. They were thin-walled and irregularly rounded in shape. The vascular bundles were 15 to 18 scattered bundles in outline, collateral types; each vascular bundle consisted of phloem and xylem tissues; phloem consisted of sieve tube elements and companion cells, the phloem cells were very small; xylem tissues were made up of 3 to 7 layers, xylem consisted of vessel, tracheids, fibres and xylem parenchyma cells. They were shown in figures 11 - 12.

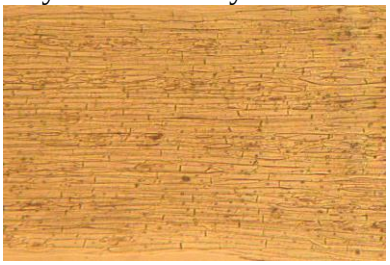


Fig. (11) Surface view of midrib X 100

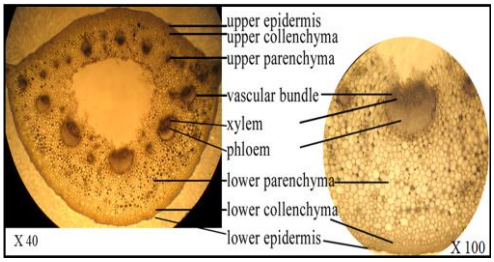


Fig. (12) T. S of midrib

Petiole

In surface view, the epidermal cells of both surfaces were parenchymatous, thin-walled and rectangular to polygonal in shape and elongated along the length of the petiole. Stomata, starch grains and oil cells were present on the both surfaces. In transverse section, the petiole was slightly convex in the upper surface and moderately concave in the lower surface. The cuticle layers of the both surfaces were thickness. The cortex was made up of lamella collenchyma and thin-walled parenchymatous cells. The collenchyma cells were 4 to 6 layers in thickness towards the upper surface and 4 to 10 layers in thickness towards the lower surface. They were rounded to isodiametric in shape. The parenchyma cells were 5 to 10 layers in thickness above the sclerenchyma and 7 to 18 layers in thickness below the sclerenchyma. They were thin-walled and irregularly rounded in shape. The vascular bundles were 15 to 18 scattered bundles in outline, collateral types; each vascular bundle consisted of phloem and xylem tissues; phloem consisted of sieve tube elements and companion cells, the phloem cells were very small; xylem tissues were made up of 5 to 9 layers, xylem consisted of vessel, tracheids, fibres and xylem parenchyma cells. They were shown in figures 13 - 14.

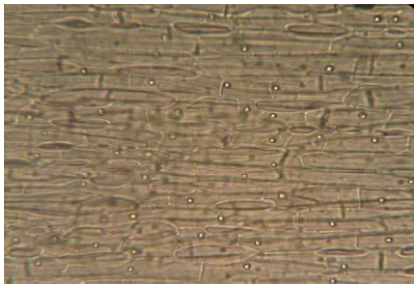


Fig. (13) surface view of petiole X 100

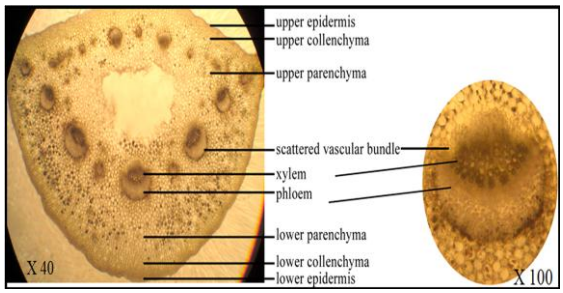


Fig. (14) T. S of petiole

1.4 Diagnostic characters of *Taraxacum officinale* F.H.Wigg.

1.4.1 Sensory characters of dandelion powdered leaves

The sensory characters of dandelion powdered leaves were dark green in colour. The odour pleasant smell (aromatic) and the tea taste (bitter) were pleasant (characteristics). The texture was granular. These were shown in Figure 15.

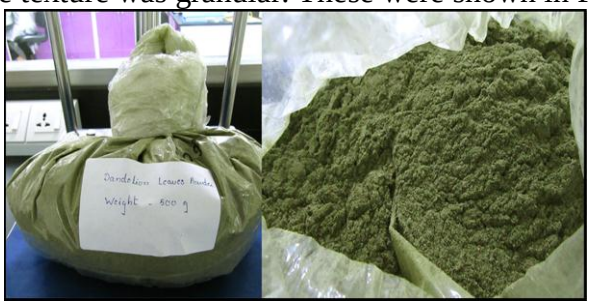


Fig. (15) Dandelion powdered leaves

1.4.2 Microscopical characters of dandelion powdered leaves

Microscopical characters of dandelion powdered leaves consists were shown in fig.16.

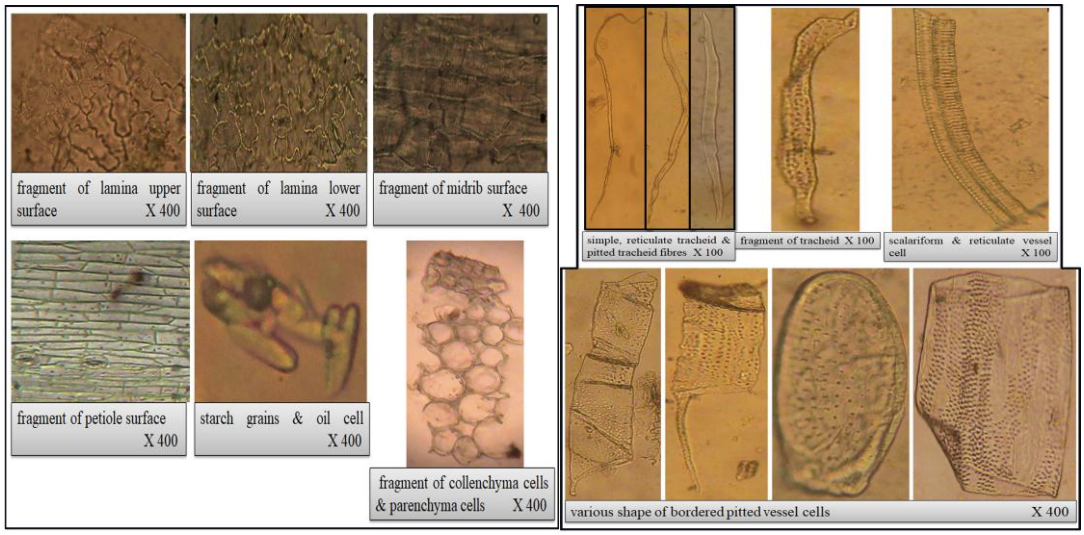


Fig. (16) Microscopical characters of dandelion powdered leaves X 400

2. Chemical studies

2.1 Qualitative investigation on dandelion powdered leaves

The qualitative investigations (Phytochemical test) were carried out on the dandelion powdered leaves. The preliminary phytochemical test in order to find out the types of phytoorganic constituents such as alkaloids, glycosides, reducing sugars, α-amino acid, saponins, flavonoids, phenolic compound, carbohydrates, starches, tannins and cyanogenic glycosides. According to the procedures as mentioned from the results are summarized in Table (1).

Table 1. Preliminary phytochemical tests on dandelion powdered leaves

No.	Constituents	Extracts	Test reagent	Observation	Results	
					H_2O	EtOH
1	Alkaloid	H_2O EtOH	1.Mayer's reagent 2.Dragendroff's reagent	1. White ppt 2. Orange ppt	+ +	+ +
2	Glycoside	H_2O EtOH	10 % lead acetate solution	White ppt	+	+
3	Reducing sugar	H_2O EtOH	Benedict's solution	Brick red ppt	+	+
4	α-amino acid	H_2O EtOH	Ninhydrin Reagent	Deep pink & violet colour	+	+
5	Saponin	H_2O EtOH	Distilled water	Foaming	+	+
6	Flavonoid	H_2O EtOH	dilHCL & small piece of zinc/ magnesium	Reddish brown colour	+	+
7	Phenolic compound	H_2O EtOH	3% Ferric chloride solution	Brown colour	+	+
8	Carbohydrate	H_2O EtOH	10% α-napthol +Conc: H_2SO_4	Red ring	+	+
9	Starch	H_2O EtOH	Iodine solution	Bluish black colour	+	+
10	Tannin	H_2O EtOH	1% Ferric chloride solution	Yellowish brown & Bluish black colour	+	+
11	Cyanogenic glycosides	H_2O EtOH	Sodium picrate paper	Not change colour	-	-

(+) = presence, (-) = absence

2.2 Quantitative investigation on dandelion powdered leaves

To identify the structures of isolated compounds, they were firstly characterized by determination of their physical properties such as pH value, total ash, moisture contents, water soluble and ethanol soluble matters. From the results of physico-chemical properties, the moisture content was usually determined by drying to constant weight and taking the loss in weight as moisture. Total ash content were also examined and recorded. The solubility of powdered leaves were carried out to find the amount of total solids soluble in solvent. All these values were useful for the quality control system regarding the physico-chemical ash and impurities whenever it was used for medicinal purposes. The different soluble matter contents were shown in Table (2).

Table 2. Physico-chemical tests on dandelion powdered leaves

No.	Composition	Contents (%)
1	pH value	5.95
2	Total ash	6.68
3	Moisture content	4.85
4	Water soluble matter	38.26
5	Ethanol soluble matter	12.61

2.3 Nutritional value investigation on dandelion powdered leaves

For quality control assessment of the medicinal plant materials, nutritional values such as protein, fat, fiber and carbohydrate of dandelion powdered leaves were also determined. The results for these contents are summarized in Table (3).

Table 3. Nutritional values on dandelion powdered leaves

No.	Composition	Contents (%)
1	Protein	12.43
2	Fat	8.12
3	Fiber	5.37
4	Carbohydrate	62.55

2.4 Safety tests on dandelion powdered leaves

Some safety tests of arsenic and aflatoxin for dandelion powdered leaves, they were firstly determination by quality control assessment of the medicinal and culinary plant. These tests results were shown in Table (4).

Table 4. Safety tests on dandelion powdered leaves

No.	Composition	Result of powdered leaves	Standard
1	Arsenic (ppm)	Not detected	< 5
2	Aflatoxin (ppb)	8.459	< 20

2.5 Thin Layer Chromatography (TLC) tests on dandelion powdered leaves

By analyzing the TLC chromatogram of polyphenols, one can note the presence of several spots corresponding to compounds with flavonoid behaviour. Among these spot R_f value 0.48 was the scientific literature mentions the presence of caffeic acid. These tests results were shown in figure (17).

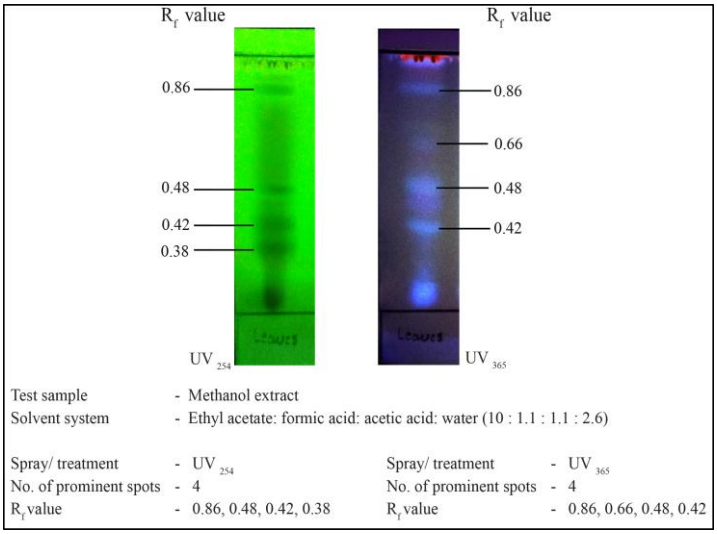


Fig. (17) TLC chromatogram of polyphenols in methanolic extract prepared from dandelion powdered leaves (viewed with a UV lamp at 254 and 365 nm)

Discussion and Conclusion

In this research paper, the whole plant of *Taraxacum officinale* F.H.Wigg. is a perennial herbaceous tap root and produces one to more than ten stems tall. The stems (modified peduncle) can be bear solitary inflorescence heads that are held as taller than the foliage. The foliage leaves are Dent-de-Lion (Lions Tooth) resemble the jagged edged leaves that taper at the tip, usually lay flat to the ground and are formed in a circular arrangement (rosette). Inflorescences bear yellow ray florets only, two series of involucral bract and flat receptacles present. Modified ray florets are bisexual, 5-dentate corolla lobe and persistent of modified calyx present. Achenes are 5-angled, straight tapering to a truncate base with small overlapping flat spines at the top. Modified stalk is called a beak, between the persistent calyx (pappus) and the achene, which elongates as the fruit matures. These characters were in general agreement with those mentioned by Hooker (1882), Dassanayake (1980), Backer (1965) & Wikipedia (2017).

In the microscopical characters of *Taraxacum officinale* F.H.Wigg (Dandelion leaves) studies, the lamina was dorsiventral, epidermal cells of upper and lower surface were wavy, palisade parenchyma (2 layers) consisted of upper epidermis and spongy parenchyma consisted of lower epidermis. Stomata were present on both surfaces, usually more present on lower surface, they were anomocytic types; surface view of midrib and petiole epidermal cells were rectangular to polygonal in shape, in transverse section made up of lamella collenchyma and thin-walled parenchymatous cells, vascular bundles were scattered bundles in outline, collateral types, vascular bundles consisted of phloem and xylem tissues, phloem consisted of sieve tube elements and companion cells, xylem consisted of vessel, tracheids, fibres and xylem parenchyma cells. These characters are agreement with those mentioned by Metcalfe and Chalk (1950) and Trease and Evans (1978).

Diagnostic characters of dandelion powdered leaves samples were observed. The sensory characters were found to be dark green colour, pleasant smell (aromatic) odour, bitter (tea) taste, granular texture and in the microscopical characters were found to be fragment of upper and lower lamina, fragment of midrib and petiole surface layer, abundance of starch grains and oil cells, fragment of collenchyma and parenchyma cells, various fibres, fragment of various tracheid and various vessel cells were observed. All these characters mentioned above can be used for identification

and standardization in traditional values of drug. All these characters are not mentioned by previous researchers. These characters were in general agreement with those mentioned by Trease and Evans (1978) & Metcalfe and Chalk (1950).

Chemical studies such as, preliminary phytochemical screening of water and ethanol extracts powdered leaves were showed the presence of alkaloids, glycosides, reducing sugars, α-amino acid, saponins, flavonoids, phenolic compound, carbohydrates, starches and tannins whereas cyanogenic glycosides were not detected in both extracts. Among them, alkaloids, reducing sugar and flavonoid were prominently observed. All characters mentioned by Central Council Research in Unani Medicine (1987), Trease and Evans (1978).

Physico-chemical properties of powdered leaves were showed in pH value (5.98 %), total ash content (6.68 %), moisture content (4.85 %), water soluble matter (38.26 %) and ethanol soluble matter (12.61 %) those could be used for the organic matter determined. These all statements were in general agreement with those mentioned by British Pharmacopeia (1968) and W.H.O (2011).

Some nutritional values tests of powdered leaves were showed in protein content (12.43 %), fat content (8.12 %), fiber content (5.37 %) and carbohydrate content (62.55 %) respectively. Those could be mentioned above can be used for consumers to understand the nutrition contents of individual food products, compare nutrition contents across product categories and choose among relevant food alternatives. These all statements were in general agreement with those mentioned by Horwitz (2000), Kjeldahl (1883) and Kirk & Sawyer (1991).

Some safety tests of powdered leaves were found to be not detected on arsenic content and less than 20 ppb on aflatoxin (8.459 ppb) content. All these characters mentioned above can be used for helps to identify and assess potential risks in plant equipment. These all statements were in general agreement with those mentioned by Leszczynska, *et al*. (1998).

TLC chromatogram tests on the powdered leaves extract were showed in R_f values 0.86, 0. 48, 0.42, 0.38 (viewed with UV lamp 254nm) and R_f values 0.86, 0. 66, 0. 48, 0.42 (viewed with UV lamp 365nm) observed spots respectively. There are agreed (Popescu, *et al*. (2010)) with R_f values 0.48 of the scientific literature mentions the presence of caffeic acid.

All characters mentioned above can be used for identification and standardization in beneficial effect of alternative medicinal and culinary plant. Therefore, the present research deals with traditional medicine were given knowledge for local people and useful for the investigation of effective pharmacological research in the coming future.

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