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## A Review on Pharmacological Activity of Dandelion Plant



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### ABSTRACT

Dandelion is family of flowering plants that grow in many parts of the world. They are also known as *Taraxacum* spp. *Taraxacum officinale* is the most common species belong to the family Asteraceae. Dandelion is highly nutritional from root to flower. These are the plant loaded with vitamins, minerals, fibre. It also reduces cholesterol, reduces blood pressure, boosts the immune system, skin treatment such as acne. Thus *Taraxacum officinale* have been used in folk medicine in China and India. Since the plant have wide variety of therapeutic activity. The dandelion plant have antioxidant, antiinflammatory, antidiabetic, anticancer, hepatoprotective effect, antifibrotic effect, inhibitory effect on HIV-1 replication and reverse transcription activity, gastrointestinal activity, diuretic activity, antimicrobial activity. The proposed review on pharmacological activity of Dandelion by the rigorous fractionation and isolation of the active principle in the various extraction of the plant is revealed that it improves the therapeutic activity and reduces the risk of certain diseases.

## INTRODUCTION

The history of using herbs to treat disease and improve health has been common in humans. Many drugs are isolated and extracted from herbs. Medicinal plants and medicinal herbs are the source of secondary metabolites and essential oils of therapeutic use of medicinal plants, many disorders, make their safety safer because they are economically really, and economically easily available [1].

The plants of the species *Taraxacum officinale*, also known as Dandelion, belong to the family Asteraceae. These perennial are widespread in the warmer temperate zone of the northern hemisphere and have been used for centuries as a cure for various diseases by many societies. Dandelion plays a central role in Traditional Chinese Medicine (TCM) and frequently used for the treatment of tumors of the breast, uterus and lungs, as well as hepatitis and the digestive disease.[2,3]. While the native Americans uses dandelion routes and herbs to cure kidney disease, dyspepsia and heartburn. In traditional Arabic medicine, dandelion has been used treat liver and spleen disorder [4]. While Europeans herbalists allow the use of dandelion against the fever, boils, eye problem, diabetes and diarrhea[5]. The variety of health benefit associated with the use of dandelion has been attributed to specific species of *Taraxacum* in the form of whole plant extract or specific plant parts.

The plant generally has deeply toothed, hairless leaves 5 to 30 cm long and 1 to 10 long wide. It reaches 3 to 35 cm height and forms leafless hollow stems that emerges from the centre of the rosette. Each flower includes a collection of florets. Dandelions have pivortry roots, tapered 2 to 3 cm wide and at least 15 cm long. The roots are freshy and brittle and have dark brown colour on the outside and white colour on the inside. It is originally from Europe, it is now found in the northern temperate zones[6].

### Anticancer Effect

Increase in the world's aging population, as well as the adoption of cancer causing behavior, are the main factors contributing to the global escalation of different form of cancer. There are more than 12 million new cases of cancer each year and more than 7 million cancer deaths worldwide.

### **Cervical cancer**

Cervical cancer is the fourth most common malignant tumor in the world. In recent years, the incidence of cervical cancer has been increasing steadily with the trend in younger patients. It is due to the infection with the HPV. Chemotherapy and radiation therapy are common treatment for cervical cancer. TO contain the taraxasterol and taraxerol in its roots, which are reported to be commercially important anticancer compound. TO flower hydraulic extract has anticancer effect on cervical cancer cells in cell culture. It has shown that TO root can induce apoptosis in human cancer cells without effect on non-cancer cells. Further research is also needed to clarify the mechanism by which the TO flower extract exert its anticancer effect on cervical cancer cells[7].

### **Breast cancer**

TO are often used in traditional Chinese medicine for the treatment of cancer and that there is anecdotal information on the valuable anticancer activity of TO. Aqueous Dandelion Leaf Extract (DLE) significantly reduces the growth of MCF-7/A2 breast cancer cells in dose dependent manner, which was not due to its direct cytotoxicity as analysed by 16 test MTT. DLE do not influence the growth of LNCaP C4-2B prostate cancer cell nor did it prepare aqueous extract prepare in the same way from the root and the flower. The inhibition of tumor cell proliferation by active extract of TO have already been shown to be due to triterpenoids and sesquiterpenoids [8,9]. The dandelion root extract inhibit the invasive behavior of MCF /A2 cells, but not the LNCaP C4-2B cancer cells.

The inhibitory effect of DLE and DRE on the invasiveness of the LNCaP C4-2B and MCF 7/A2 cells are demonstrated by zymographic analysis revealing that DLE and DRE inhibit the genolytic activity of MMP-2 and MMP-9, since the enzymatic activity of these matrix metalloproteinases correlate with the tumorigenicity and metastatic capacity of the tumor cells [10]. The exact reason for the reduction of invasion cannot be explained at present, as many known components in all roots and leaves may contribute to the observed effect.

### **Colorectal cancer**

Colorectal cancer, also known as bowel cancer, colon cancer or rectal cancer is the development of cancer from the colon or rectum. Most colorectal cancer are due to the old age and lifestyle factors, with only a small number of cases due to underlying genetic

disorders. Aqueous DRE has the cancer cell killing effectiveness in colon cancer cell models. The aqueous DRE selectively induced programmed cell death (PCD) in >95% of colon cancer cells, regardless of their p53 status, after 48 hours of treatment the anticancer efficacy of this extract have been confirmed by *in vivo* studies, the administration of the oral DRE having delayed by more than 90% of the growth of xenograft models of the human colon. There is activation of several death pathways in cancer cells by treatment with DRE, as revealed by the gene expression analyzes showing the expression of gene involved in the PCD. Phytochemical such as  $\alpha$ -amyrin,  $\beta$ -amyrin and taraxasterol. Thus the natural extract could effectively engage and target multiple vulnerabilities of the cancer cells. Therefore DRE could be nontoxic and effective anticancer alternative, essential for cancer drug resistance [11].

### **Liver cancer**

Hepatocellular carcinoma (HCC) is one of the most common malignancies, responsible for 90% of primary liver cancer. TO root extract have great potential as non-toxic and effectiveness alternatives to conventional chemotherapy modes available today. Dandelion said to induce cytotoxicity in the Hep G2 cells and decrease its viability to below 40%. The TO extract significantly induce secretion of TNF $\alpha$  and IL-1 $\alpha$  and apoptosis of Hep G2 cells [12]. These strategies are clearly involved in the anticancer efficacy of dandelion. There is another factor that is the dandelion polysaccharide (DP), it has the anticancer activity. DP significantly inhibited *in vitro* and *in vivo* cell proliferation of HCC and induced apoptosis and cell cycle arrest in the G0/G1 phase. In addition, the RNA sequencing data revealed that DP attenuated to P13K-AKT signalling pathway. Western blot result confirmed that DP treatment negatively controlled p-P13K, p-AKT and p-MTOR levels in HCC cells, suggesting that DP inhibited the P13K/AK/MTOR pathway. In addition, immune phenotyping experiment showed that DP significantly improved spleen index, spleen germinal centre response, and modulated T cells activation *in vivo*, which could contributed to inhibition of tumor growth in animals. In summary, DP be a potential drug candidate for the treatment of HCC [13].

### **Antidiuretic Effect**

Taraxacum species have been used as a diuretic for over 2000 years in traditional Chinese medicine and Ayurvedic medicine. Given the mineral content and the antioxidant activity of

dandelion, an interesting possibility is to use dandelion as an adjuvant with pharmaceutical diuretics. Since the combination of potassium and magnesium as a supplement has been shown to be as effective as KCl, the mineral content of the dandelion leaf with potassium at  $\approx 42.5$  mg/g and magnesium at  $\approx 2.5$  mg/g can alleviate some of the electrolyte imbalance resulting from the use of pharmaceutical diuretics. Animal models have shown that supplementation with dandelion greens results in less potassium and magnesium being eliminated than the amount contained in dandelion extract[14]. Considering the tissue damage induced by oxidative stress due to the use of dandelion extracts, which have been shown to have substantial antioxidant activity, could be advantageous. Many of the complications of pharmaceutical diuretics can be alleviated by proper dosing and replacement of lost electrolytes. Therefore, the combination of dandelion extract with a pharmaceutical product should be studied.

Of the half dozen modes of activity by which diuretics increase the flow of urine, the most effective pharmaceutical diuretic action by a simple path called "loop diuretics" affecting the reabsorption of sodium in the loop henle. The diuretic compounds found in plants may be due to several constituents of the secondary metabolite such as terpenes, phenolic compounds or alkaloids. According to the USDA database, dandelion contains up to nine diuretic compounds (table). The diuretic activity of dandelion can be due to several compounds via various diuretic and saluretic routes. Since these active components have many other beneficial effects (table), including favorable cardiovascular activity, further analysis is needed on the potential therapeutic role of dandelion leaf.[14].

**Table No. 1: Diuretic compounds in *Taraxacum officinale* and their additional properties**

Compounds	Other activities of diuretic compounds
Ascorbic acid	Nutrient
Calcium	Nutrient
Chlorogenic acid	Antiinflammatory, antioxidant,
Caffeic acid	Antiaggregant, anxiolytic, antioxidant
Magnesium	Nutrient
Mannitol	Antiinflammatory, antioxidant
Pottassium	Nutrient

From Ref.15

### **Antidiabetic Activity**

Diabetes is characterized by a persistent rise in blood sugar, and its control consists in keeping blood sugar around normal. Many studies have been conducted on the therapeutic effect of dandelion; however, after systematically reviewing the literature, only one study found to have investigated its hypoglycemic effect on the leaves and roots of dandelion induced by streptozotocin, and this has been done in animals (rats). The results of the study indicate that the leaves have a blood tremor effect in the leaf extract root intervention group, but the root extract is better for the treatment and management of diabetes [16]. It contains what is responsible for lowering blood sugar in diabetic rats. Tannins are anti-nutrients that have the ability to bind to digestive amylase, thus preventing action on digestion. This slows the rate carbohydrate digestion by competing for enzymes, thereby reducing the glucose level in the blood. The hypoglycemic effect of dandelion has also been linked to the presence of inulin in dandelion, which is also an anti-nutritional factor. Glucose molecule after digestion, which makes them suitable for absorption. The results that suggest that dandelion increases the frequency and urine production have 2 dimensions: it increases or decreases in normal people. First, dandelion can increase blood sugar, thereby increasing the frequency of urination. The frequency of urination is related to the response of blood glucose to maintain a blood sugar balance, hence frequent urination to eliminate excess blood sugar; therefore, in reality, Dandelion can increase blood glucose levels by increasing the production and frequency of urination to reduce the level of blood glucose, which means that it helps lower glucose levels in the body by increasing the frequency and flow of urine. Increase the blood flow and frequency of urine, with regard to its effect on blood sugar. However, this study is carried out in the healthy individual and the same conclusion cannot be drawn, based on these results, for diabetic patients. Therefore, it is necessary to study how dandelion affects the frequency of urination as well as the production of urine in patients with Type 2 diabetes [17].

### **Hepatoprotective Activity**

The liver is one of the vital organs of the human body, being involved in a myriad of vital functions and in the regulation of physiological processes. Due to its unique anatomical location and function, the liver is vulnerable to many forms of damage. Dandelion (*Taraxacum officinalis*), a traditional herbal medicine, is used to treat jaundice and disorders

of the liver, gallbladder, and other various liver conditions. Folk remedies from China, India and Russia have recognized the effect of dandelion as a liver tonic. Traditional Chinese medicine combines dandelion with other herbs to treat hepatitis. Conventionally, the roots and herbs of *Taraxacum officinale* (TO) have been used for the treatment of various ailments, in particular liver and gallbladder disorders [18].

### **Antioxidant activity**

Oxidative stress is a common feature seen in a wide range of chronic liver diseases, including viral hepatitis, alcoholic and non-alcoholic steatohepatitis. Oxidative stress causes deleterious processes in the liver and causes liver disease. Therefore, the restoration of antioxidants is essential to maintain homeostasis. An antioxidant restoration method is suggested to consume natural compounds with antioxidant capacity. Dandelion, a natural antioxidant compound has been used empirically due to its beneficial health properties as an anti-carcinogen, anti-inflammatory and anti-oxidant. The ethanol leaves and the TO root extract considerably reduced the enzymes which marked liver toxicity (AST and ALT), lipid peroxidation and oxidative stress induced by acetaminophen in mice. The TO extract was found to possess free radical quenching activities. These protective effects of TO have been suggested in the presence of phenolic compounds in the extract. In a recent study, the extract of ethanol and n-hexane TO leaves significantly reduced hepatic marker enzymes, superoxide dismutase (SOD), catalase, lipid peroxidation and glutathione peroxidase (GPx) in rats poisoned by CCl<sub>4</sub>. The efficacy of the ethanolic extract of TO leaves was found to be more effective than that of the n-hexane extract and silymarin against CCl<sub>4</sub>-induced hepatotoxicity and oxidative stress in rats[19]. In the model of oxidative stress induced by CCl<sub>4</sub>, the extract reverses the depletion of glutathione (GSH), the upregulation of nuclear factor-kB (NF-kB) and the increase in the expression of regulatory inflammatory mediators, such as inducible nitric oxide synthase (iNOS), cyclooxygenase (COX) -2, Tumor necrosis factor -  $\alpha$  (TNF- $\alpha$ ) and interleukin (IL) 1 $\alpha$ . Alcohol is one of the main causes of liver disease and is associated with significant morbidity and mortality. Alcohol-induced liver disease represents a spectrum of liver pathology ranging from fatty changes to fibrosis to cirrhosis. *In vitro*, the protective effects of the TO root against alcoholic liver damage have been studied in HepG2/2E1 cells[18]. In this study, ROS was generated by the administration of ethanol *in vitro*, which resulted in a decrease in cell viability of less than 40%. However, the cells were treated



simultaneously with ethanol and the TO hot water root extract did not induce cytotoxicity compared to HepG2 / 2E1 cells treated with ethanol alone.

### **Anti-fibrotic activity**

Hepatic fibrosis is a common sequela after chronic liver injury and reversing the fibrosis before it reaches the cirrhotic stage would be a clear therapeutic strategy. The TO extract has been evaluated against drug and chemical induced liver fibrosis in laboratory animals and has shown promising results. For example, water-ethanolic dandelion root extract (DWE) has been reported to improve CCl<sub>4</sub>-induced liver fibrosis in mice. Administration of 600 mg/kg of DWE for 10 days in mice shows a significant reconstitution of the markers aspartate and alanine hepatic transaminases (AST and ALT) of hepatotoxicity, superoxide dismutase, hydroxyproline and  $\alpha$ -SMA ( $\alpha$ -SMA) expression proteins in CCl<sub>4</sub> induced by hepatic fibrotic mice CCl<sub>4</sub> [20]. In addition, this study suggests that the TO administration promotes the complete regression of fibrosis and the enhancement of the hepatic regeneration capacities.

### **Antisteatotic effect**

Steatosis or alcoholic fatty liver disease has a widespread incidence and is the first step in the progression to more severe stages of alcoholic liver disease, with concomitant increases in morbidity and mortality. One of the classic models for evaluating the lipid-lowering activity of the drug and the plant extract is the lipid changes induced by CCl<sub>4</sub> in the liver. Ethanol and n-hexane let the TO extract significantly lower the lipid profile in rats on CCl<sub>4</sub>. Interestingly, TO significantly reduces the increase in triglycerides (TG), cholesterol (CHO), high and low density lipoproteins (HDL and LDL)[19]. Dandelion leaf extract is reported to have the ability to reduce the mouse model of diet-induced methionine and cholinuria (NASH) nonalcoholic steatohepatitis. Based on these studies, it has been suggested that TO may also be a promising agent and should be tested for fatty liver disease. In a recent study, TO leaf extract was found to be effective against CCl<sub>4</sub>-induced fatty liver disease in rats. The grade of steatosis has been shown to be significantly reduced with the administration of TO leaf extract.

Overwhelming evidence clearly suggests that dandelion is widely used in traditional and natural medicine systems around the world. So far, it has received little research on its beneficial effects against various liver conditions. From the studies reviewed here, it is clear that TO have the capacity to intervene in various pathophysiological functions related to the



liver. Extensive literature search reveals that *Taraxacum officinalis* or dandelion appears to be safe and that the available evidence on mechanisms of action appears promising, data from well conducted clinical trials are currently insufficient to recommend their use in patients with chronic liver disease.

### **Anti- HIV Activity**

Acquired immunodeficiency syndrome (AIDS), which is caused by the human immunodeficiency virus (HIV), is an immunosuppressive disease that results in life-threatening opportunistic infections. General problems with current therapy include the constant emergence of drug-resistant strains of HIV, unwanted side effects, and unavailability of treatment in developing countries. Natural herbal products capable of inhibiting the life cycle of HIV-1 at different stages have served as excellent sources of new anti-HIV-1 drugs. In this study, we sought to study the anti-HIV-1 activity of aqueous dandelion extract. The pseudotyped HIV-1 virus was used to explore the anti-HIV-1 activity of dandelion, the level of replication of HIV-1 was evaluated by the percentage of GFP positive cells. The inhibitory effect of dandelion extract on reverse transcriptase activity was assessed by the reverse transcriptase test kit. Compared with control values obtained from infected cells without treatment, the level of HIV-1 replication and reverse transcriptase activity decreased in a dose-dependent manner. The data suggest that dandelion extract has potent inhibitory activity against HIV-1 replication and reverse transcriptase activity. The identification of antiviral compounds HIV-1 in *Taraxacum officinale* should be continued. The dandelion extract showed strong activity against HIV-1 RT and inhibited both the HIV-1 vector and the replication of the hybrid MoMuLV / MoMuSV retrovirus. These results provide additional support for the potential therapeutic efficacy of *Taraxacum officinale*. Extracts from this plant can be considered as another starting point for the development of antiretroviral therapy with fewer side effects[21].

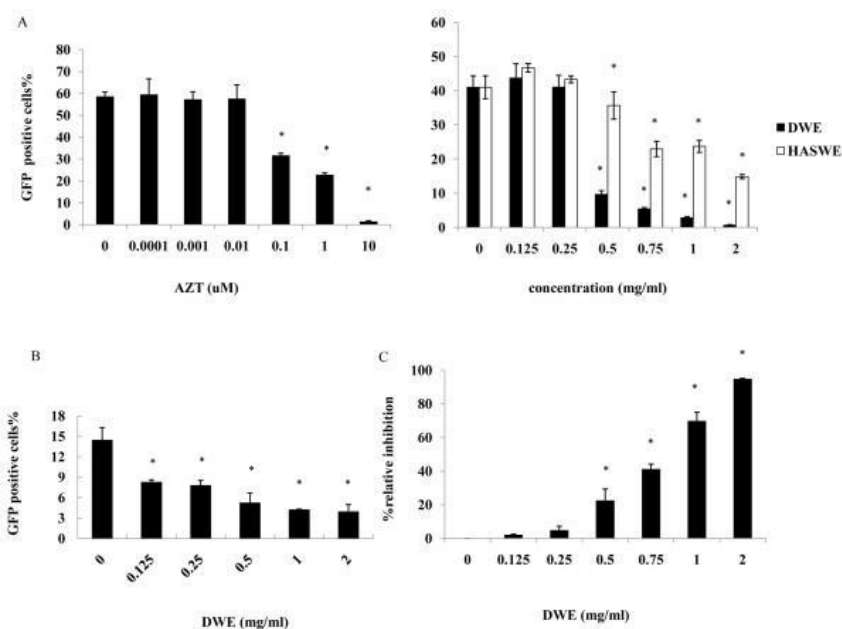
The present study demonstrates for the first time that DWE has an inhibitory effect on HIV-1 replication and RT activity. Extracts containing marked concentrations of chlorogenic acid have been reported to inhibit HIV reverse transcriptase. Dandelion is rich in phenolic compounds, particularly chlorogenic acid, caffeic acid, various flavonoid glycosides such as luteolin 7-O-glucoside, luteolin and others, however, as shown in Figure 5, the analysis HPLC of two plant species Compositae has shown that *HerbaArtemisiae* The extract of *Scopariae*, which contains higher levels of chlorogenic acid and caffeic acid than those of

DWE (212 times and 7 times, respectively), has shown inhibitory activity milder on HIV1 replication. Since DWEs are a mixture of components, it is possible that the anti-HIV-1 compound is new. The isolation of the active components against HIV-1 RT from *Taraxacum officinale* is now underway. The activity presented by DWE provides evidence to validate their effect against HIV-1.

Cell tests are one of the high-throughput screening tests used to identify new inhibitors that target at different stages in the life cycle of HIV-1. Infectious single-cycle HIV-1 pseudotyping using the vesicular stomatitis virus (VSV-G) envelope glycoprotein may mimic certain behaviors of wild-type viruses. High titer stocks of the single cycle infectious virus can be generated from producer cells. In addition, by using single-cycle infectious viruses in the HIV-1 retrovirus, the tests significantly reduce the security risk encountered with HIV-1 competent for replication. Taking these elements into account, the experts stress the importance of developing cell-based screening systems for the rapid identification of new anti-HIV agents. In addition, to explore the different mechanisms of anti-HIV-1 activity, the choice of an appropriate cell line is a critical step. Human Jurkat CD4 + cells are commonly used to screen for anti-HIV-1 drugs, but other reports have indicated that dandelion root extract shows selective induction of apoptosis through activation of caspase -8 in human leukemia (Jurkat). In the study, we used the pseudotyped HIV-1 VSVG, which has a different route of entry than wild-type HIV-1, and a non-CD4 cell line. The test used here targeted replication of HIV-1, a post-entry event. A deletion in the U3 region results in the loss of promoter activity after reverse transcription and integration. The only promoter that dictates transcription of a reporter gene is the CMV internal promoter. Thus, the expression of the GFP protein is a reliable indicator of the replication of HIV-1[22]. It is also important to distinguish specific antiretroviral activity from non-specific inhibitory effects or from cytotoxicity induced by DWE. We have combined cytotoxicity data with antiretroviral testing to solve this problem. DWE has been studied in mice, and administration of DWE at 1 g / kg/day for 4 weeks has been reported to have no adverse effects.

In conclusion, the dandelion extract showed strong activity against HIV-1 RT and inhibited both the HIV-1 vector and the replication of the hybrid retrovirus MoMuLV / MoMuSV. These results provide additional pharmacological information on the potential therapeutic efficacy of *Taraxacum officinale*. This could represent another starting point for the development of antiretroviral therapy with fewer side effects. This preliminary discovery

suggested isolating the bioactive compound from biologically active extracts for further study. Activity tests of the components of the plant extracts would be carried out for anti-HIV-1 activities. It is desirable to determine the effects of DWE on wild-type HIV-1 as well as to try to isolate the active components.



**Figure No. 1: Inhibitory effect of DWE on HIV-1 and other retrovirus**

## CONCLUSION

Many herbal medicines are included in several Ayurvedic formulations that have been shown to be anti-cancer, anti-diabetic, diuretic, hepatoprotective and anti-HIV activity. This implies that many other herbal medicines have yet to be studied for their safe use in humans. Such a lavish treasure trove of Ayurveda and herbal medicine should also be well established and protected.

The present study reveals that dandelion is widely used in traditional and natural medicine systems around the world. So far, it has received little research on its beneficial effects against various liver conditions. In light of the studies reviewed here, it is obvious that dandelion has the ability to intervene in various pathophysiological functions related to the liver. The extensive literature search reveals that dandelion appears to be safe and that the available evidence for the mechanism of action appears promising; data from well-conducted clinical studies are currently insufficient to recommend their use in patients with chronic liver disease.

Data from the human trial show that an ethanolic extract of fresh dandelion leaf (1 g: 1 ml) increases the frequency and rate of excretion of fluids in healthy human subjects. These results suggest that further investigation is warranted.

The evidence presented in the review shows that there is a big problem in using dandelion as an anti-diabetic herb, although many studies have demonstrated its therapeutic use. This review found only one study conducted to determine the anti-diabetic effect of dandelion; however, this was an animal study, hence the need for well-designed clinical trials to verify this claimed therapeutic effect of dandelion. This review is preliminary data for further studies on the use of dandelion not only for the management of diabetes but for its other therapeutic uses.

This review shows the anticancer potential of the aqueous extract of plant parts in several models of cancer cells, without toxicity for non-cancer cells. Multiple death pathways are activated in cancer cells by DRE treatment. Therefore, ERD could be a non-toxic and effective anticancer alternative, essential for reducing the development of drug cell resistance in cancer cell.

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