

REVIEW

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A comprehensive review of the benefits of *Taraxacum officinale* on human health

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Abstract

Background: *Taraxacum officinale* (G.H. Weber ex Wiggers), commonly known as dandelion, is a herbaceous plant native to North America, Europe and Asia. This plant has been used for health purposes since ancient times. The phytochemicals present in different parts of the plant are responsible for its medicinal properties. In this review, we describe the main health properties of *Taraxacum officinale*.

Main body of the abstract: We searched for the main medicinal properties of *Taraxacum officinale* in the scientific literature, using the PubMed database. We selected 54 studies and we described twelve therapeutic properties, which are reported in previous studies. These properties are diuretic, hepatoprotective, anticolitis, immunoprotective, antiviral, antifungal, antibacterial, antiarthritic, antidiabetic, antiobesity, antioxidant and anticancer effects. We also found that the most frequently reported therapeutic effects include hepatoprotective, antioxidant and anticancer activities.

Short conclusion: In this review, we describe the medicinal properties of *Taraxacum officinale* reported in previous studies. Antioxidant, hepatoprotective and anticancer effects are mostly found in the scientific literature.

Keywords: *Taraxacum officinale*, Dandelion, Medicinal properties, Hepatoprotective, Antioxidant, Anticancer

Background

Taraxacum officinale (G.H. Weber ex Wiggers), commonly called dandelion, is a perennial plant belonging to the family Asteraceae. This plant is found in Europe, Asia and North America and is a very common weed spreading in gardens, agricultural crops, pastures and wasteland. The plant is about 40 cm tall and is characterized by yellow to orange flowers and jagged leaves (Fig. 1). The name "*Taraxacum*" comes from the Greek words "taraxos" (disorder) and "akos" (remedy). The word "*officinale*" denotes a plant having medicinal properties. It is noteworthy that this herb has been used as a medicinal plant from ancient times. The root and the young tops are mainly used for medicinal purposes (Grieve 1931; Rasool and Sharma 2014; Stewart-Wade et al. 2002). The young leaves of *Taraxacum officinale* are also used as a food in salads, drinks and vegetable dishes, due to its nutritional

value. Research studies show that the *Taraxacum officinale* leaves contain high concentrations of fiber, minerals, vitamins and essential fatty acids (Escudero et al. 2003).

Taraxacum officinale has many medicinal properties, due to phytochemicals found in flower, leaf and stem and roots of the plant. The main phytochemicals are: carotenoids; flavonoids (e.g., quercetin, chrysoeriol, luteolin-7-glucoside); phenolic acids (e.g., caffeic acid, chlorogenic acid, chicoric acid); polysaccharides (e.g., inulin); sesquiterpene lactones (e.g., taraxinic acid, taraxacoside, 11 β ,13-dihydrolactucin, ixerin D, taraxacolide-O- β -glucopyranoside); sterols (e.g., taraxasterol, β -sitosterol, stigmasterol); triterpenes (e.g., α -amyrin) (Amin Mir et al. 2013; Singh et al. 2008) (Fig. 2).

There are more than 2500 different species of *Taraxacum* and the most studied are *T. officinale*, *T. mongolicum*, *T. platycarpum*, *T. laevigatum* and *T. kok-saghyz*. *Taraxacum officinale* represents the most studied species and the main species are native to different parts of the world. For example, *T. mongolicum*, *T. platycarpum*, *T. laevigatum* and *T. kok-saghyz* are native to China,

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Korea, Europe and Central Asia, respectively. *Taraxacum* is used for similar medicinal purposes in different countries, although some species native to a particular region have uncommon medicinal uses. For example, *T. crepidiforme* is used for treating eyes disease in Turkey (Martinez et al. 2015).

The aim of this review is to find the main medicinal properties of *Taraxacum officinale*, searching the scientific literature. This plant has a very important role in traditional and complementary medicine and is used by physicians and herbalists to solve many health problems. For this reason, this review is of great importance for all the practitioners who can use this plant as a health remedy. This work is also relevant for the researchers who are studying the medicinal properties of *Taraxacum officinale*, as they will know the latest research findings in this field.

Main text

We searched for scientific articles related to the effects of *Taraxacum officinale* on human health using PubMed (www.ncbi.nlm.nih.gov/pubmed). We used the following keywords: "*Taraxacum officinale*", "dandelion", "properties of *Taraxacum officinale*", "properties of dandelion", "phytoterapy of *Taraxacum officinale*" and "*Taraxacum officinale* and disease treatment". Then we extended our search using the following keywords: "diuretic *Taraxacum officinale*", "hepatoprotective *Taraxacum officinale*", "*Taraxacum officinale* and colitis", "immune effects of *Taraxacum officinale*", "antiviral *Taraxacum officinale*", "antifungal *Taraxacum officinale*", "antibacterial *Taraxacum officinale*", "antiarthritic *Taraxacum officinale*", "antidiabetic *Taraxacum officinale*", "antiobesity *Taraxacum officinale*", "antioxidant activity *Taraxacum officinale*" and "anticancer *Taraxacum officinale*".

Firstly, scientific articles were selected depending on their titles. Secondly, we read the abstracts and we selected only the articles relevant to the topic of the present study. Finally, we read all the selected articles and we chose the articles suitable for our research.

In total, we found 54 studies relevant to the topic of this review. The results show that twelve medicinal properties of *Taraxacum officinale* are reported in the scientific literature. These properties include diuretic (4 studies), hepatoprotective (7 studies), anticolitis (5 studies), immunoprotective (4 studies), antiviral (5 studies), antifungal (1 study), antibacterial (4 studies), antiarthritic (1 study), antidiabetic (5 studies), antiobesity (6 studies), antioxidant (12 studies) and anticancer (7 studies) activities. The therapeutic effects of *Taraxacum officinale* which are mostly reported in the scientific literature are antioxidant, hepatoprotective and anticancer activities.

Diuretic activity and treatment of urological diseases

One previous study found that *Taraxacum officinale* extracts have diuretic activity in a mouse model (Râcz-Kotilla et al. 1974). A study by Clare et al. (2009) showed that this plant ethanolic leaves extract increases urinary frequency and fluid excretion in healthy individuals. Other two studies showed a positive effect of *Taraxacum officinale* extract on the treatment and prevention of kidney diseases, such as urolithiasis (Ghale-Salimi et al. 2018; Karakus et al. 2017) (Table 1).

Hepatoprotective effects

Research studies reveal that *Taraxacum officinale* is useful for preventing and treating liver diseases. One study showed that two polysaccharides found in this plant are effective for preventing acetaminophen (APAP)-induced liver injury (AILI) in a mouse model (Cai et al. 2017).

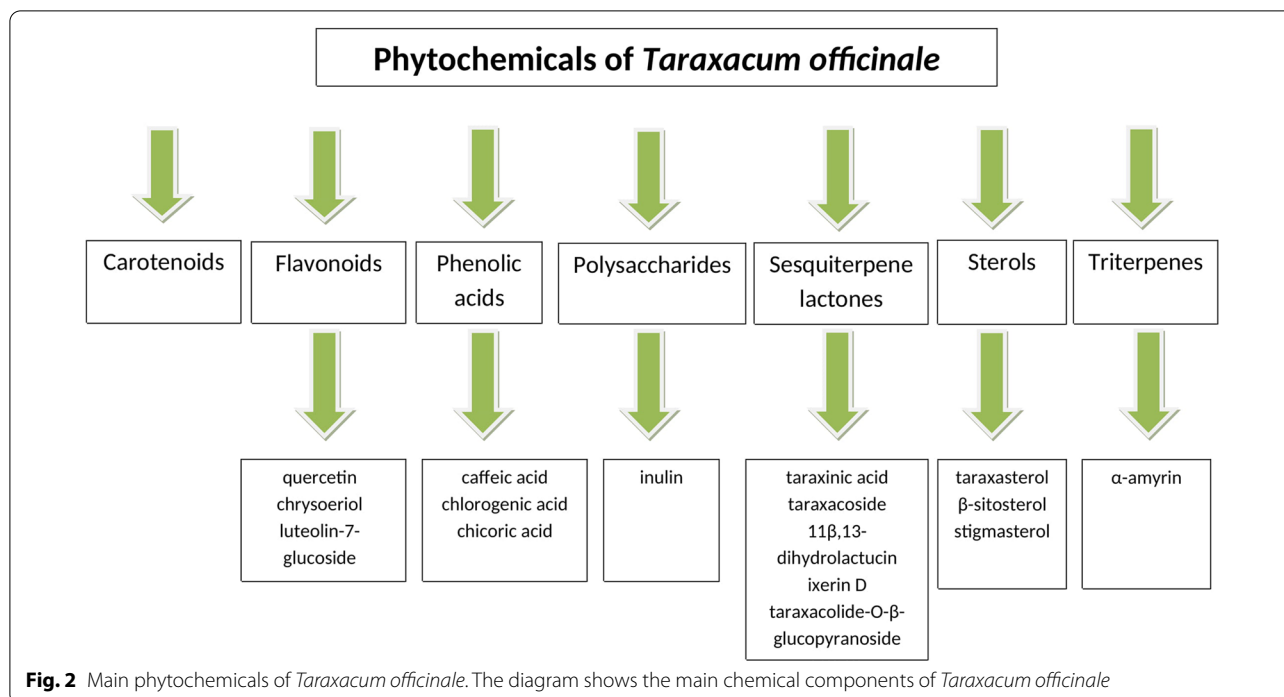


Table 1 Medicinal properties of *Taraxacum officinale*. The results of literature review are reported in the table

Medicinal properties of <i>Taraxacum officinale</i>	References
Diuretic activity and treatment of urological diseases	Clare et al. (2009), Ghale-Salimi et al. (2018), Karakus et al. (2017), Răcz-Kotilla et al. (1974)
Hepatoprotective effects	Cai et al. (2017), Colle et al. (2012); Davaatseren et al. (2013a), Davaatseren et al. (2013b), Hfaiedh et al. (2016), Park et al. (2010), You et al. (2010)
Treatment of colitis	Chen et al. (2019a), Chen et al. (2019b), Ding and Wen (2018), Han et al. (2017), Wang et al. (2017)
Effects on the immune system	Kim et al. (1998), Lee et al. (2012), Sang et al. (2019), Tan et al. (2017)
Antiviral effects	Flores-Ocelotl et al. (2018), Han et al. (2011), He et al. (2011), Rehman et al. (2016), Yang et al. (2020)
Antifungal activity	Liang et al. (2020)
Antibacterial activity	Diaz et al. (2018), Kenny et al. (2015), Qian et al. (2014), Wang (2014)
Antiarthritic activity	Wang et al. (2016)
Antidiabetic effects	Akhtar et al. (1985), Choi et al. (2018), Davaatseren et al. (2013b), Guo et al. (2019), Hussain et al. (2004)
Antiobesity activity	Aabideen et al. (2020), Choi et al. (2010), García-Carrasco et al. (2015), Davaatseren et al. (2013b), Răcz-Kotilla et al. (1974), Zhang et al. (2008)
Antioxidant activity	Aabideen et al. (2020), Choi et al. (2010), García-Carrasco et al. (2015), Guo et al. (2019), Hu and Kitts (2005), Ivanov et al. (2018), Jedrejek et al. (2017), Jedrejek et al. (2019), Lis et al. (2020), Milek et al. (2019), Park et al. (2011), Park et al. (2014)
Anticancer effects	Nassan et al. (2018), Nguyen et al. (2019), Ovadje et al. (2011), Ovadje et al. (2012), Ovadje et al. (2016), Saratale et al. (2018), Sigstedt et al. (2008)

A study by Colle et al. (2012) found that this plant leaf extract has hepatoprotective activity against APAP toxicity. Other studies demonstrated that *Taraxacum officinale* leaves extract is able to prevent and treat non-alcoholic fatty liver disease (NAFLD) (Davaatseren et al. 2013a, 2013b). One previous study showed that this plant leaf

extract has hepatoprotective activity against sodium dichromate-induced liver injury in vivo (Hfaiedh et al. 2016). A study by You et al. (2010) found that *Taraxacum officinale* root aqueous extract can prevent alcohol-induced liver damage and another study showed that two polysaccharides isolated from this plant exert protective

effects against hepatic damage in vivo (Park et al. 2010) (Table 1).

Activity against colitis

A previous study showed that *Taraxacum officinale* root extract can exert therapeutic property in ulcerative colitis, using in vitro and in vivo models (Ding and Wen 2018). Another study found that this plant is able to prevent colitis in a mouse model. In this study, *Taraxacum officinale* extract seems to have a stronger effect than an anti-inflammatory drug on preventing colitis. In particular, this plant prevented colitis through anti-oxidative, anti-inflammatory and regenerative activities (Han et al. 2017). One previous study found that a *Taraxacum officinale* polysaccharide can ameliorate ulcerative colitis (Wang et al. 2017). Another study demonstrated that taraxasterol is effective in the treatment of acute colitis in vivo (Chen et al. 2019a). Finally, a study by Chen et al. (2019b) showed that *Taraxacum officinale* extract is able to improve the symptoms of colitis controlling fatty acid metabolism and dysbiosis (Table 1).

Effects on the immune system

Previous studies found that *Taraxacum officinale* extract improves immunity, increasing nitric oxide (NO) and cytokines production in mice (Kim et al. 1998; Lee et al. 2012). Another study showed that taraxasterol can activate the Bax/Bc1-2 anti-apoptotic signalling pathway, which is downregulated in autoimmune disorders (Sang et al. 2019). A study by Tan et al. (2017) found that *Taraxacum officinale* extracts ameliorate the immune response in vivo (Table 1).

Antiviral activity

A study by Han et al. (2011) showed that aqueous *Taraxacum officinale* extract has antiviral activity in vitro, inhibiting human immunodeficiency virus type 1 (HIV-1) reverse transcription and replication. Another study found that this plant extract is able to prevent influenza infections by inhibiting virus replication (He et al. 2011). A recent study by Yang et al. (2020) showed that *Taraxacum officinale* extract has antiviral activity in vitro against hepatitis B virus (HBV) and the bioactive compound which exerts this action is taraxasterol. Other studies found that this plant extract has antiviral activity against the dengue virus serotype 2 (DENV2) (Flores-Ocelotl et al. 2018) and the hepatitis C virus (HCV) (Rehman et al. 2016) (Table 1).

Antifungal activity

A recent study by Liang et al. (2020) found that *Taraxacum officinale* can inhibit *Candida albicans* by disrupting the cell wall (Table 1).

Antiarthritic activity

A previous study showed that taraxasterol from *Taraxacum officinale* possesses antiarthritic effect by inhibiting inflammation in vivo (Wang et al. 2016) (Table 1).

Antibacterial activity

Two previous studies found that oligosaccharides and polysaccharides isolated from *Taraxacum officinale* exhibit an antibacterial effect against *Staphylococcus aureus*, *Escherichia coli* and *Bacillus subtilis* (Qian et al. 2014; Wang 2014). A study by Kenny et al. (2015) showed that *Taraxacum officinale* root extract has antibacterial activity against *Staphylococcus aureus* and *Bacillus cereus*. Another study found that *Taraxacum officinale* leaves extract has strong antibacterial properties against *Staphylococcus aureus* and moderate antibacterial activity against *Escherichia coli*, *Klebsiella pneumoniae* and *Proteus mirabilis* (Diaz et al. 2018) (Table 1).

Antidiabetic activity

Two previous studies found that compounds isolated from *Taraxacum officinale* exhibit hypoglycemic effects via inhibition of α -glucosidase and α -amylase (Choi et al. 2018; Guo et al. 2019). Another study showed that this plant has hypoglycemic properties in an animal model and this effect might be exerted by improving insulin secretion from the β -cells of the pancreatic islets (Akhtar et al. 1985). Another study found that *Taraxacum officinale* leaf extract lowers fasting blood glucose level and insulin resistance in vivo (Davaatseren et al. 2013b). A study by Hussain et al. (2004) showed that *Taraxacum officinale* extract enhances insulin secretion from pancreatic β -cells in vitro (Table 1).

Antiobesity activity

One study found that *Taraxacum officinale* extracts are able to reduce body weight in a mouse model (Rącz-Kotilla et al. 1974). Previous studies showed that *Taraxacum officinale* exerts hypolipidemic effects in vivo (Choi et al. 2010; Davaatseren et al. 2013b) and in vitro (García-Carrasco et al. 2015). A study by Zhang et al. (2008) showed that *Taraxacum officinale* can inhibit pancreatic lipase in vivo and in vitro and can have an anti-obesity effect. A recent study by Aabideen et al. (2020) found that this plant has hypolipidemic activity via inhibition of pancreatic lipase (Table 1).

Antioxidant activity

Previous studies showed that *Taraxacum officinale* has antioxidant activity in vivo (Choi et al. 2010) and in vitro (Ivanov et al. 2018; Milek et al. 2019; Park et al. 2011). Two studies found that polysaccharides from this plant have antioxidant activity in vitro (Guo et al. 2019; Park

et al. 2014). Other studies demonstrated that polyphenols contained in *Taraxacum officinale* exert antioxidant effects in vitro (Aabideen et al. 2020; García-Carrasco et al. 2015; Hu and Kitts, 2005; Jedrejek et al. 2017; Jedrejek et al. 2019; Lis et al. 2020) (Table 1).

Anticancer activity

Previous studies showed that *Taraxacum officinale* has anticancer activity in different types of cancer. One study showed that *Taraxacum officinale* extracts block proliferation and invasion of breast and prostate cancer cells (Sigstedt et al. 2008). Another study demonstrated that this plant extract can inhibit proliferation and growth of breast cancer cells, regulating phosphatidylinositol 3-kinase (PI3K)/ protein kinase B (AKT) pathway (Nassan et al. 2018). A study by Saratale et al. (2018) showed that *Taraxacum officinale* exerts cytotoxicity effects on human hepatic cancer cells. In vivo and in vitro studies found that this plant extracts can induce programmed cell death in different categories of cancer cells, such as human leukemia, colorectal, prostate and pancreatic cancer cells (Nguyen et al. 2019; Ovadje et al. 2011; Ovadje et al. 2012; Ovadje et al. 2016) (Table 1).

A limitation of this review is that only published studies are included. Moreover we used personal criteria for selecting articles and it could influence results and conclusions.

Conclusion

This review shows that twelve medicinal properties of *Taraxacum officinale* are commonly reported in the scientific literature. These properties comprise diuretic, hepatoprotective, anticolic, immunoprotective, antiviral, antifungal, antibacterial, antiarthritic, antidiabetic, antiobesity, antioxidant and anticancer effects. Hepatoprotective, antioxidant and anticancer activities are the most frequently reported medicinal properties of *Taraxacum officinale* in the scientific literature. This plant represents a promising source for the prevention and treatment of health conditions. The protective action of *Taraxacum officinale* against hepatotoxicity, oxidative stress and cancer cell proliferation is well reported in the scientific literature. Further research is needed for validating the medicinal properties previously described and for corroborating the use of this plant as a health remedy.

Abbreviations

AILI: APAP-induced liver injury; AKT: Protein kinase B; APAP: Acetaminophen; BCSCs: Breast cancer stem cells; DENV2: Dengue virus serotype 2; HBV: Hepatitis B virus; HCV: Hepatitis C virus; HIV-1: Human immunodeficiency virus type 1; NAFLD: Non-alcoholic fatty liver disease; NO: Nitric oxide; PI3K: Phosphatidylinositol 3-kinase; ROS: Reactive oxygen species; TRAIL: Tumor necrosis factor-related apoptosis-inducing ligand.

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Authors' contributions

ADN and PZ designed the study. ADN performed the literature search and wrote the first draft of the manuscript. ADN and PZ contributed to the final version of the manuscript. The authors read and approved the final manuscript.

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All data and material are available upon request.

Declarations

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Not applicable

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Competing interests

No competing interests to declare.

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