

Journal of Biological and Chemical Research



An International Journal of Life Sciences and Chemistry
EISSN 2319-3077 (Online) | ISSN 0970-4973 (Print)

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Journal Impact Factor: **4.275**, | Global Impact Factor: **0.876**, | InfoBase Impact Factor: **3.66**
Scientific Journal Impact Factor: **3.285**, | IC Value: **82.43**

Scope

Life Sciences (Botany and Zoology), Medical Sciences, Chemical Sciences, Agricultural Sciences, Biochemical Sciences, Environmental Sciences, Biotechnology, Molecular Biology and Tissue Culture



Volume 43 (1), January-June, 2026



Indexed, Abstracted and Cited

Index Copernicus International (Europe), Research Bible (Japan), Scientific Journals Impact Factor Master List, Directory of Research Journals Indexing (DRJI), Indian Science. In, Database Electronic Journals Library (Germany), Open J-Gate, J Gate e-Journal Portal, Info Base Index, International Impact Factor Services (IIFS) (Singapore), Scientific Indexing Services (USA), International Institute of Organized Research (I2OR), World Cat, International Innovative Journal Impact Factor, Swedish Scientific Publishing, Eye Source and cifactor.org Journals Indexing Directory, Cosmos Science Foundation South-East Asia, Indexing of International Research Journals and ImpactFactor.pl - Compendium wiedzy o czasopismach naukowych, Philadelphia.



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REVIEW ARTICLE

Received: 18/04/2026

Revised: 29/05/2026

Accepted: 30/05/2026

Ethnomedicinal Traditions and Modern Pharmacotherapy of *Cichorium intybus*: A Broad-Spectrum Overview

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ABSTRACT

In the modern era, the exploration of herbal plants is required to sustain a healthy and disease-free lifestyle by following the traditional medicine system and to develop novel plant-based drugs for numerous therapeutic uses. Nature provides various therapeutic agents in the form of this multipurpose and medicinal plant widely known as 'Chicory' (Cichorium intybus). It shows wide distribution (major geographic presence in Asia, South Africa, and Europe) and has a rich history of use in folklore medicines. In different ethnic medicine systems, folk healers use this herb to cure various ailments such as diabetes, liver disorders, and others. Various parts of the plant contain a range of major phytochemicals (inulin, esculin, flavonoids, phenolics, sesquiterpene lactones, caffeic acid, chicoric acid, terpenoids, and vitamins) have potentially be identified and validated for some medicinal purposes. In pharmacological studies, this plant exhibited wide arrays of medicinal properties such as antimicrobial, anti-diabetic, hepatoprotective, antioxidant, etc. This chapter focuses on the basic introduction of ethnic values of Cichorium intybus and its possible remedial application for treating a vast number of ailments.

Keywords: *Cichorium intybus*, Chicory, Ethnomedicine, Phytochemicals.

INTRODUCTION

From ancient times, medicinal plants/herbs have played very important roles in various folk practices (Shaikh et al., 2016). 70 - 80% of people have a firm reliance on ethnic or traditional medicines where medicinal plants are potentially be used to accomplish their foremost health care requirement (Ekor, 2014). In ethnomedicine, the folk healers use either whole plants or parts of plants (leaves, fruits, stems, roots, etc.) for curing diseases. The extraction and isolation of various therapeutic agents from medicinal herbs are executed for the preparation of 'herbal-based drugs' (Kaisar et al., 2013). Approximately 20 - 30% of contemporary drugs have been derived from herbal plants, which are copiously used in Indian traditional medication systems (Siwach et al., 2013). *Cichorium intybus*, commonly known as 'Chicory' or 'Kasni' (belongs to *Asteraceae* family), is a small biennial or perennial,

edible, aromatic and medicinal herb generally used as 'ethnomedicine' (Ghahraman, 1994; Nandagopal and Ranjitha Kumari, 2007; Shaikh et al., 2016; Wu et al., 2018). Chicory is widely distributed in Africa, Asia and Europe, and laden with a wide spectrum of bioactive compounds (Liu et al., 2011, Dalar and Konczak, 2014; Wu et al., 2018). Most important bioactive compounds or phytochemicals present in chicory exhibit medicinal properties are inulin, esculin, flavonoids, tannins, polyphenols, coumarins, unsaturated sterols and volatile compounds such as monoterpenes and sesquiterpenes (Nandagopal and Ranjitha Kumari, 2007; Abbas et al., 2014; Rezagholizadeh et al., 2016). Chicory is used to treat digestive and hepatic disorders, as well as diabetes and inflammation. In modern research, the medicinal value of this plants has widely accepted due to its several traits such as antioxidant activities, hepatoprotective activities, anti-hyperglycemic activity, anti-inflammatory activities, antibacterial and antifungal activities (Nishimura and Satoh, 2006; Ahmed et al., 2008; Azay-Milhau et al., 2013; Xiao et al., 2013; Rezagholizadeh et al., 2016; Amer, 2018; Khalaf et al., 2018). Moreover, these medicinal properties have widened the use of chicory in phytotherapy and give the insight to explore other medicinal values with a specific mechanism against the disease. Studies performed on chicory suggests that use of the plant is safe, and plenty of clinical trials depicted the potential of this herb for postponing in the commencement of diabetes (Nishimura et al., 2015), suppression of osteoarthritis (Olsen et al., 2010) and prevention of cardiovascular ailments (Schumacher et al., 2011). On the basis of applicability, the chicory can be categorized in following types such as (a) 'industrial chicory' which can also be known as root chicory and employed for the huge production of inulin and further as a substitute of coffee, (b) 'Leaf chicory', for human consumption as a fresh salad or in cooked form and, (c) 'forage chicory' for animals/cattle feeding (Street et al., 2013; Peña-Espinoza et al., 2018). Phytochemicals showing potential for various therapeutic uses are widely distributed in all the parts of plants, but mostly root part contains very important content of effective phytochemicals (Bais and Ravishankar, 2001). This review is focused on the traditional or ethnic values of this plant and to depict the phytochemicals and to decode the role of this plant for different medicinal uses.

Ethnic Values

From the prehistoric era, plants have been used for several purposes and among all of them, the use of chicory as foods and medicines prevailed (Street et al., 2013). In India there are several traditional medication systems namely 'Ayurveda', 'Siddha' and 'Unani' (Panday et al., 2013; Shaikh et al., 2016). The olden Indian scripture such as "*Rig-Veda*" could be predicted to be as an ancient record of medicinal plants containing healing properties (Rungsung et al., 2013). In Ayurvedic traditional medication system "*Sushruta Samhita*" (Dalhancharya, 2009) and as well "*Charak Samhita*" illustrates the application of numerous medicinal plants and their different parts for curing different infectious diseases (Gewali, 2008). In numerous traditions of the globe, particularly in South Africa and India, chicory has been portrayed as multipurpose medicinal herb as this wonderful herb harbors different pharmacological activities including hepatoprotective, anticancer, antibacterial, antifungal, antiulcerogenic and anti-inflammatory activities (Nandagopal and Ranjitha Kumari, 2007; Street et al., 2013; Dalar and Konczak, 2014). Different parts of plants namely leave, roots, seeds and flowers are used in various folklore medicine systems in different parts of world (Fig. 1). In traditional medication system of India, *Cichorium intybus* has been employed to cure several ailments such as fever, jaundice, enlargement of liver and spleen, rheumatism and gout (Mulabagal et al., 2009; Das et al., 2016). The seed parts mainly used in treating

liver disorders including jaundice (Said, 1982; Ahmed et al., 2003) and the whole plant is useful in diabetes (Pushparaj et al., 2007). Moreover, chicory is also used as a vegetable as it exhibits tonic properties for liver and digestive tract (Chopra et al., 1958). The medicinal use of *Cichorium intybus* L. traditionally in Iranian folk medicine is considered as an effective blood purifier and possesses hepatoprotective property (Dorostghoal et al., 2019). In Morocco, the herbal decoction of the chicory plant is used in kidney diseases and diabetes (El-Hilaly et al., 2003). Chicory has been found to contain an elevated level of ‘inulin’ and ‘fructans’, and therefore employed to produce functional foods rich in fiber for providing the beneficiary health effects (Kaur and Gupta, 2002, Pool-Zobel, 2005). The plant is also used as a decoction or infusion for treating hemorrhoids and particularly the root decoction showed therapeutic potential for treating epilepsy (Tabata et al., 1994; Dalar and Konczak, 2014). Moreover, the plant is also used as a sunscreen replacement (Dalar and Konczak, 2014).

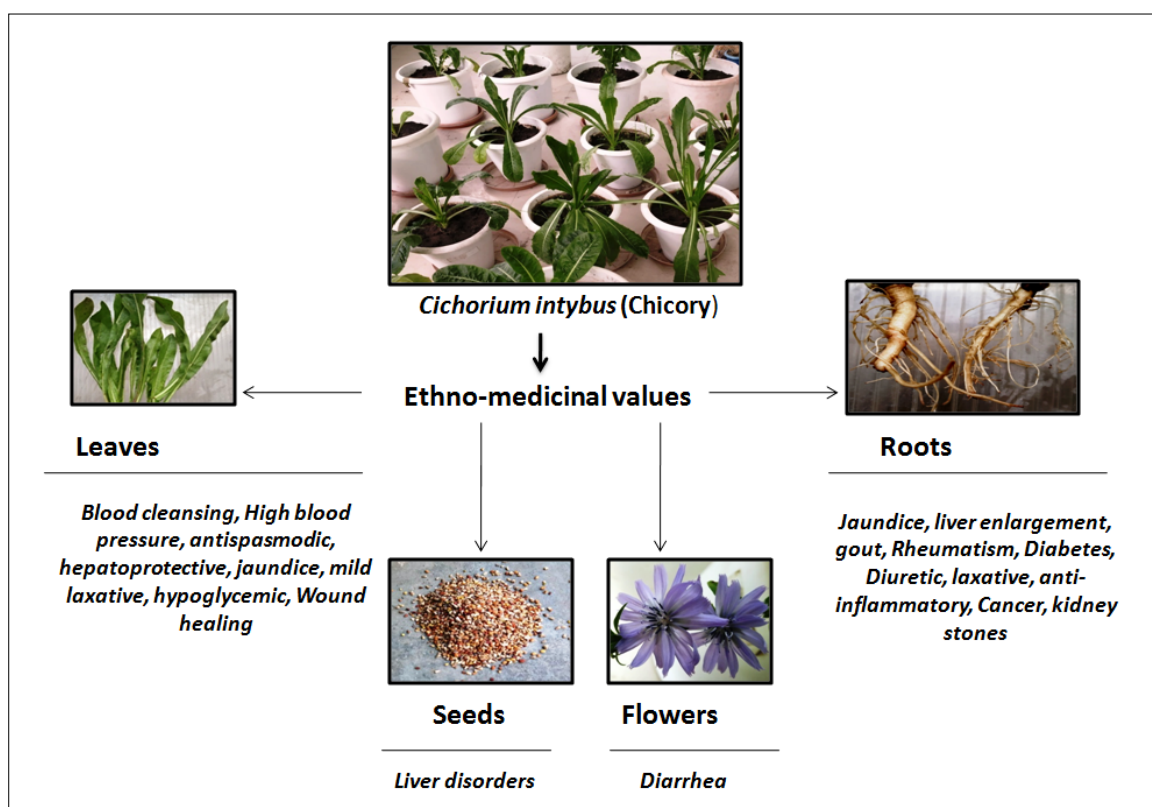


Figure 1. Different parts of *Cichorium intybus* and its medicinal uses in traditional medicine system (Li et al., 2023).

Phytochemical constituents

Bioactive compounds found in plants are illustrated as ‘phytochemicals and these compounds are widely distributed in all parts of plants. The modern research has wide attention on these plant-based chemicals which can be the striking sources for preparing different medicines and therefore may exhibit multiple and positive influences on overall human health. Most of the phytochemicals are present in the form of secondary metabolites, and broadly these can be categorized into three main groups such as phenolics, alkaloids, and terpenes (Kennedy and Whitman, 2011). The important phytochemical constituents of *Cichorium intybus* present in different plant parts are depicted in Table 1.

Table 1. The phytochemical constituents in different parts of *Cichorium intybus*.

	Plant parts	Phyto-chemicals	References
1	Leaves	Hydroxycinnamic acids (gallic, protocatechuic, caffeic, chlorogenic, caffeic and chicoric acids) the flavonoids (luteolin 7-O glucuronide, apigenin, apigenin glucuronide, apigenin 7-O arabinoside, quercetin 3-O-glucuronide, quercetin 3-O-galactoside, quercetin 3-O-rhamnoside, quercetin malonyl glucoside, kaempferol 3-O-glucoside, kaempferol 3-O-glucuronide, methyl quercetin glucuronide, kaempferol malonyl glucoside, methyl quercetin glucoside, isorhamnetin 3-O-glucuronide and isorhamnetin); the anthocyanins (cyanidin 3-O-glucoside, cyanidin 3-O-rutinoside, pelargonidin 3-O-glucoside, peonidin 3-O-glucoside, malvidin 3-O-glucoside, cyanidin 3-malonylglucoside, delphinidin 3-O-(6" malonyl)-glucoside, cyanidin 3-O-(6" malonyl)-glucoside, pelargonidin, peonidin and malvidin), sesquiterpene lactones (lactucin (LAC), 8-deoxylactucin (DOL), and lactucopicrin (LPIC))	Rees and Harborne, 1985; Llorach et al., 2004; Innocenti et al., 2005; Rossetto et al., 2005; Heimler et al., 2009; Sareedenchai and Zidorn, 2010; Foster et al., 2011; Ferioli and D'Antuono, 2012; Carazzone et al., 2013; Dalar and Konczak, 2014; Sinkovič, et al., 2015
2	Roots	Sesquiterpene lactones (lactucin, lactucopicrin, 8-deoxy lactucin, glycoside Picriside B, sonchuside A, cichoriosides, crepidiaside B, 11 β, 13 dihydrolactucin and glycoside sonchuside C), flavonoids (quercetin 3 galactose), inulin, phlobaphenes caffeic acid, chicoric acid, pectin, fixed oils, cholin, fatty acids (generally palmitic and linoleic), tannin and reducing sugar	Wealth of India, 1950; Seto et al., 1988; Kirtikar and Basu, 2006; Nandagopal and Kumari, 2007; Pushparaj et al., 2007
3	Seeds	Triterpenoids (lupeol, friedelin, beta-sitosterol, stigmasterol, betulinic acid, betulin, betulinaldehyde, syringic acid, vanillic acid, 6,7-dihydroxycoumarin, methyl-alpha-D-galactopyranoside, cichoridiol and intybusoloid), phlobaphenes, reducing sugars	Atta-ur-Rahman et al., 2008; Shaikh et al., 2010
4	Flowers	Saccharides, methoxycoumarin, cichorine, flavonoids, essential oils, anthocyanins, lactucin, intybin, and colourless crystalline glucoside	Judžentienė and Budiene, 2008; Shaikh et al., 2010; Street et al., 2013

All parts of plants such as leaves, stems, roots, fruits, flowers, and seeds encompass wide arrays of phytochemicals and each specific part of the plant may contain phytoconstituents having therapeutic potential against health-related disorders. The seeds of *Cichorium*

intybus have already shown medicinal values and are known to be enriched with different phytochemicals such as alkaloids, tannins, saponins, flavonoids, triterpenoids, fatty acids and volatile oils (Nandagopal and Ranjitha Kumari, 2007). The seeds of chicory are rich in triterpenoids cichoridiol and intybusoloid along with other known compounds such as syringic acid, beta-sitosterol, lupeol, betulinic acid, sigmasterol, betunaldehyde and vanillic acid (Atta-ur-Rahman et al., 2008). The volatile compounds namely octane, pentadecanone, hexadecane *n*-nanodecane, and pentasalicylate have also been detected (Judžentiene, and Budiene, 2008). The root portion of the plant presents excellent medicinal activities and various phytochemicals such as sesquiterpene lactones, flavonoids (Kirtikar and Basu, 2006) and inulin (Pushparaj et al., 2007). Chicory leaves are the finest sources of phytochemicals particularly 'phenols', biomolecules (vitamin A and C) and as well some elements such as calcium, phosphorus and potassium (Mulabagal et al., 2009; Katiyar et al., 2015). Cichorin, coumarins, esculetin, sesquiterpene lactones, cichosterol (seco-sterol), lactucopicrin, 11,13-dihydrolactupicrin and cichoridiol were also reported in leaves and root of chicory (Katiyar et al., 2015). The flower part of chicory also contains numerous chemicals such as essential oils, saccharides, flavonoids and methoxycoumarin cichorine (Judžentiene and Budiene, 2008), and furthermore the well-known pigment namely 'anthocyanins' contribute in imparting the blue coloration of the perianth (Norbak et al., 2002). Additionally, chicory is rich in chicoric acid that may improve the immune system, avert inflammation and to some extent prevents bacterial infections (Nayeemunnisa, 2009). Besides the presence of inulin, chicory also contains sesquiterpene lactones, minerals and vitamins which give mild bitter taste and impart the property of laxative (Chevallier, 1996; Katiyar et al., 2015).

Medicinal uses

Cichorium intybus used as a substitute of coffee bean and considered as most commonly used herb in traditional medication system for curing several health-related disorders. The interest has been increased in the exploration of plant-based drugs as the folk medicines are the finest sources for deriving novel drugs (Abdallah, 2011). But, due to the inadequate investigation and poor documentation of plants used in traditional medication system by the folk healers, there is likely the loss of such ancient knowledge (Idrisi et al., 2010). Therefore, the urgent need is aroused to screen the plants used as folk medicines and their scientific validation for determining active principles through carrying out certain experimental studies that may include isolation and characterization of phytoconstituents. In recent researches, the interest has been augmented to find out natural antioxidants from plants and their potential use in food or in medicines (Mehmood et al., 2012). Chicory has been investigated in terms of medicinal values but still, further work is also required in the sense of phytochemistry and as well pharmacology (Street et al., 2013). There are numerous compounds that have been detected in extracted residues of several plant parts. The potential application of chicory has been established as this plant has several medicinal properties such as hepatoprotective activity, antioxidant activity, antimicrobial activity, anti-diabetic activity, anti-inflammatory activity, anti-carcinogenic activity, analgesic activity, and anti-malarial activity (Alshaghдали et al., 2024).

Antimicrobial Activity

Microorganisms show the resistance towards various antimicrobial drugs and make themselves strong to live for a long time and further cause different infectious diseases and other ailments in humans (Tchakam et al., 2012). Therefore, plants-based drugs or herbal plants may serve as a potential alternative of synthetic antimicrobial drugs to defend against

pathogenic microorganisms. Plants are a rich source of antimicrobial substances that are used for suppression of bacteria showing patterns of antibiotic resistance and therefore using plant-based drugs can present crucial steps for eradication of threat posed by antibiotic resistance microorganisms (Amer, 2018). The potential results gathered from herbal plants provoke the more use and exploration of herbal-based medicines for curing various bacterial infections or diseases. Therefore, chicory (*Cichorium intybus*) might be used as herbal medicine in curing bacterial infections against a number of both Gram-negative and Gram-positive bacteria. The alcoholic extract of this herb showed potential antimicrobial actions against a wide range of bacterial pathogens. The leaf extract (methanolic extract) exhibited moderate antimicrobial activity against enteric bacterial pathogens (Rani and Khullar, 2004). Furthermore, the aqueous and alcoholic based (ethanolic and ethyl acetate) extracts of aerial portion and root of plants were reported to be effective antibacterial agents against a number of bacteria, particularly Gram-positive (*Bacillus subtilis*, *Staphylococcus aureus* and *Sarcina lutea*) and Gram-negative (*Pseudomonas aeruginosa* and *Pseudomonas fluorescens*) (Petrovic et al., 2004). Ethyl acetate and water fractions of chicory showed antifungal activity against *Aspergillus niger* and *Fusarium solani* (Rehman et al., 2014). The aqueous extracts of chicory seeds depicted potential antibacterial activity against *Staphylococcus aureus* whereas ethanolic and ethyl acetate extracts were potential in showing antibacterial activity against *Staphylococcus aureus* and *Pseudomonas aeruginosa* (Sheikh et al., 2016). The antimicrobial activity of *Cichorium intybus* against *Bacillus cereus* suggested using of chicory as a natural antimicrobial substance for the safety of dairy products (Jeong et al., 2016). Modern researches are having an interest in finding natural or plant-based agents which could target numerous virulence traits of bacteria, and this approach can be a promising alternative tactic to antibiotic based therapy. This approach would have the immense benefits in terms of combating the infection process with no development of antibiotic-resistant pattern in cells, and this strategy further depicts its advancement as it does not disrupt the microbiota of host (Signoretto et al., 2012; Papetti et al., 2013). Anti-virulence activity against some oral pathogens (*Actinomyces naeslundii*, *Streptococcus mutans*, and *Prevotella intermedia*) was reported in the low molecular mass extract of chicory (*Cichorium intybus* var. *silvestre*). Moreover this anti-virulence activity is due to the presence of some components (oxalic, succinic, shikimic and quinic acids), and involves in the prevention of pathogens participate in tooth decay and gingivitis (Papetti et al., 2013).

Hepatoprotective Activity

The liver is determined as the most important organ which participates in the defense mechanism of the body against bacteria and other exogenous/foreign macromolecules. The highest level of the enzymatic system present in the liver have the capacity to transform or metabolize foreign chemicals and hence results in detoxification and activation of endogenous compounds (fatty acids and steroids) and exogenous compounds (drugs and insecticides) (Zhou et al., 2025). Moreover, liver harbors well-developed organelles which involve in the synthesis of various compounds such as albumin, cholesterol, and fibrinogen. Hepatotoxicity is considered as a worldwide serious health problem, and the major progression in liver diseases has been provoked by the formation of free radicals or reactive oxygen species (Cemek et al., 2010; El-Sayed et al., 2017). Free radicals of carbon tetrachloride (CCl₄) reduce the activity of antioxidant enzymes such as glutathione (GSH) of phase II detoxification enzymes and GSH-dependent antioxidant enzymes, and thus results in the onset of oxidative stress, which is an important factor for acute and chronic liver

damage (Szymonik-Lesiuk et al., 2003; Preethi and Kuttan, 2009). Therefore, the role of antioxidants became imperative as they can show a potential role as a hepatoprotective activity through elimination of reactive oxygen species (ROS) and free radicals. *Cichorium intybus* has been portrayed as an important hepatoprotective plant in Unani medication system and this herb is very useful in liver-related disease such as jaundice and hepatitis (El-Sayed et al., 2017). Elgengaihi et al., (2016) ascertained the hepato-protective activity of various extracts of chicory against carbon tetrachloride intoxicated albino rats. The aqueous-methanolic extract from the seeds of *C. intybus* determined for its hepatoprotective activity against carbon tetrachloride and acetaminophen induced liver damage in mice, and also depicted the reduced death rate and also brought down the serum levels of glutamyl pyruvate transaminase, alkaline phosphatase and glutamylboxaloacetate transaminase (Gilani and Janbaz, 1994). Moreover, the root callus extract of *Cichorium intybus* root extract was tested to be a better mean for could afford better protection against hepatocellular damage in comparison to natural root extract (Zafar and Mujahid, 1998).

Anti-Inflammatory Activity

Plant extracts derived from *Cichorium intybus* exert significant anti-inflammatory activity, as the alcoholic extract of this plant exhibited anti-inflammatory potential in curing pyorrhea inflammation (Papetti et al., 2013). The inhibition of TNF- α (tumor necrosis factor-alpha) mediated cyclooxygenase (COX) induction by ethyl acetate extracts from roots of chicory was determined in human colon carcinoma cell lines, and also examined the inhibitory potential of ethyl acetate extract against the synthesis of PGE₂ (prostaglandin E₂) in dose-dependent mode (Cavin et al., 2005). The anti-inflammatory activity of *C. intybus* has also shown in carrageenan induced paw edema model where the root extract of chicory reduced the levels of TNF- α and interleukin ((IL-6 and IL-1). This scenario has resulted in enhanced anti-oxidant property in paw tissue and thus suggested that both anti-inflammatory and anti-oxidant properties of chicory roots might be due to the inhibition of cytokines (Rizvi et al., 2014).

Antidiabetic Activity

'Diabetes' at the worldwide level has been considered as an important health-related risk factor and mainly related to vitiated glucose metabolism. Impaired insulin secretion or lesser sensitivity of insulin functions are the main factors for causing diabetes, which is categorized as type 1 and type 2 diabetes (Nashar et al., 2019). A number of plants have been explored for curing diabetes, but *C. intybus* as a dietary supplement can be used for the hindrance of the onset of diabetes (Chandra et al., 2018). Moreover, potent phytochemicals of this plant are still needed to be explored for the management of this escalating disease. Plant extract of chicory depicted good anti-diabetic activity as the extracts have the potential of inhibition of digestive enzymes (especially α -glucosidase) and exert a modulatory effect on the secretion of insulin (Dalar and Konczak, 2014). *In vitro*, a natural chicoric acid extract (NCRAE) from *Cichorium intybus* root has been shown to increase insulin secretion by pancreatic β -cells and glucose uptake by muscle cells (Azay-Milhau et al., 2013). Two important compounds namely caffeic acid and chlorogenic acid have been illustrated as antidiabetic-agents as these two increased glucose uptakes in muscle cells and were found to be capable for stimulating insulin from insulin-secreting cell lines and islets of Langerhans (Tousch et al., 2008). In a study carried out by Pushparaj et al., (2007) determined the antidiabetic effect of ethanolic extract on streptozotocin induced rats (male Sprague-Dawley rats) and results were extrapolated through some traits such as

reduction in serum triglycerides, cholesterol, hepatic glucose-6-phosphatase activity and attenuation of serum glucose level. Antidiabetic activity of chicory seed was determined in both early and late stage of diabetes in mice (male Wistar albino rats) where the test extract was found to stop weight loss in both stages. Moreover, in early stage the chicory extract has led to the elevation in insulin level and maintained the normalization of blood parameters (such as total cholesterol, alanine aminotransferase, glycosylated hemoglobin, and triacylglycerol) (Ghamarian et al., 2012).

Antioxidant Activity

Firstly the conceptual statement and role of free radicals in aging was depicted by D. Harman, 1956 (Oloyede et al., 2013). Free radicals mainly described as unpaired electron those formed in the body and exhibit crucial roles in different pathophysiological conditions (Valko et al., 2006). Oxygen, nitrogen and numerous heavy metals are the important factors for the production of free radicals causing oxidative damage which ultimately leads to the carcinogenicity, mutagenicity, and cytotoxicity (Oloyede et al., 2013). Singlet oxygen, reactive oxygen species (ROS), superoxide, hydroxyl radical, hydrogen peroxide, nitric oxide, and transition metal ions are the main free radicals showing toxicity in living organisms (Valko et al., 2006). If the free radicals are in minute quantity, then they exhibit positive roles in cellular responses against defense from infectious agents or may tempt mitogenic response. On the contrary, an elevated level of free radicals is tremendously reactive and commences oxidative damage to biomolecules namely nucleic acids, protein, and lipids (Bratic et al., 2013). To conquer the needless consequence of free radicals, living beings acquire natural antioxidant defense mechanisms by various kinds of enzymes (peroxidase, catalase, and glutathione). Though the defensive roles of these enzymes may be limited due to the high production of ROS, creating a condition of cellular oxidative stress in consequence of the dissimilarity between antioxidant and free radical or oxidant species in the living system (Gasca et al., 2013). Therefore, the phytochemicals as potential bioactive compounds prevent the ailments associated to the condition of oxidative stress by maintaining a satisfactory balance in living organisms (Gasca et al., 2013; Goyal et al., 2013). The leaves of chicory are prosperous in terms of having several natural antioxidants, therefore show the importance for pharmaceutical and nutritional need. Polyphenols present in red chicory exert significant antioxidant activities (Lavelli et al., 2008). Chicory extracts (both aqueous and alcoholic extract) were found to be potential for free radicals scavenging activities. Seed extracts of chicory particularly methanolic extracts or ethyl acetate fraction had shown remarkable antioxidant potential by scavenging of DPPH radical (Mehmood et al., 2012). It has been reported that the phytochemicals such as chlorogenic acids, cichoric acids and caftaric acid are the main source of antioxidant potential of *Cichorium intybus* (Dalar and Konczak, 2014). The noteworthy potential of the red chicory (*C. intybus* var. *silvestre*) was determined under the *ex vivo* test by showing protective activity against lipid peroxidation in rat hepatocytes (Gazzani et al., 2000; Papetti et al., 2002). The seeds of *Cichorium intybus* contain an elevated number of anthocyanins which might show antioxidant activity through scavenging ROS (Devdi et al., 2013). Natural antioxidants found in chicory boot up the antioxidant defense machinery and avert the hepatocellular injury induced by CCl₄ (El-Sayed et al., 2017).

Tumor-Inhibitory Activity

Very few reports are available on tumor inhibitory potential of *Cichorium intybus*. In a study, the root extract of this plant showed profound inhibitory potential when it was tested on 'Ehrlich tumor carcinoma' and exerted a significant effect through increased life span (70%)

of mice (Hazra et al., 2002). The antiproliferative property of chicory leaves was also estimated on amelanomatic C32 cell lines, (Conforti et al., 2008) while on the other hand a root-derived compound namely 'Magnolialide' was effective in inhibition of numerous tumor cell lines and also resulted in initiating differentiation process of human leukemia cells (HL-60 AND u-937) to macrophage or monocyte-like cells (Lee et al., 2000).

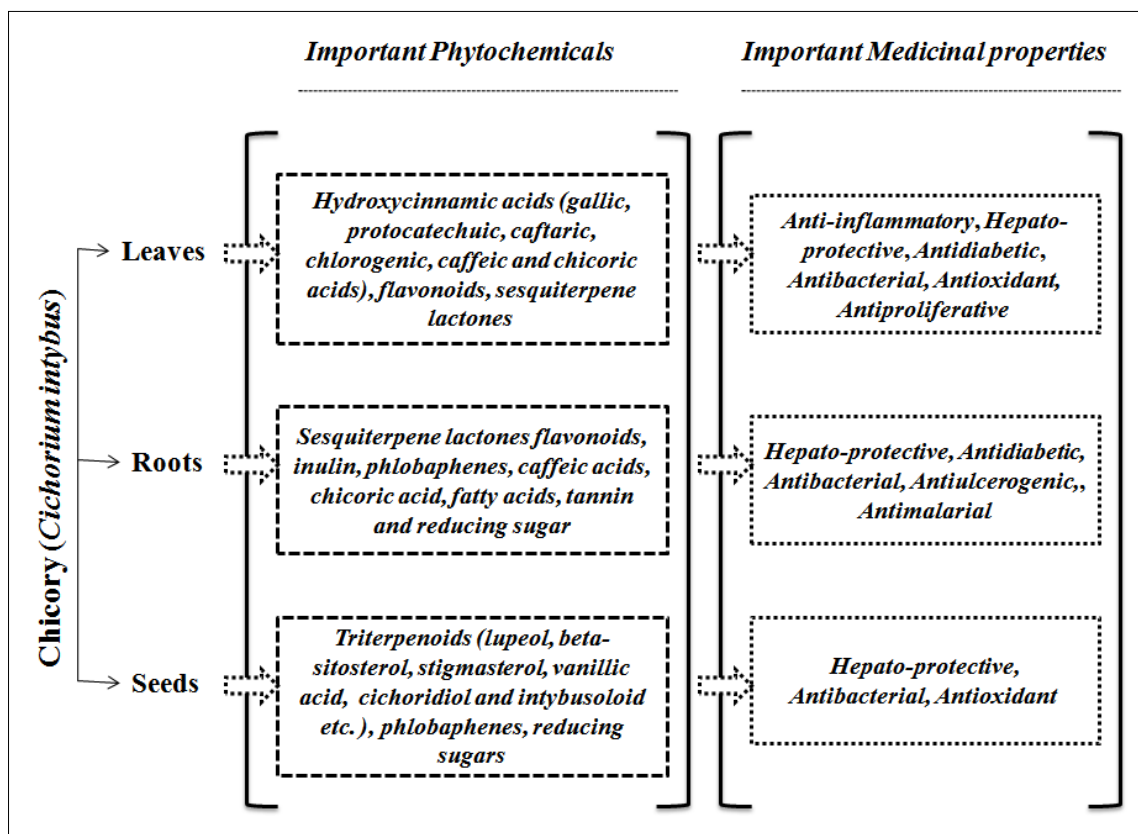


Figure 2. Schematic representation of plant parts of *Cichorium intybus* with important phytochemicals and medicinal properties (Meng et al., 2022).

Other medicinally Important Activities

The methanolic extract of chicory displayed wound healing property (Süntar et al., 2012) while the aqueous extract showed antiallergic activity under both *in-vitro* and *in-vivo* through inhibiting mast cell-mediated allergic response and reduction in the level of some markers of allergic reactions (reduced plasma histamine levels and histamine secretion from peritoneal mast cells of rat) (Kim et al., 1999). The chicoric acid showed vasorelaxant trait, while the dichloromethane extract of root parts of chicory and two sesquiterpene lactones (8-deoxylactucin and lactucopicrin,) exhibited anticholinesterase activity (Sakurai et al., 2003; Rollinger et al., 2005). The aqueous-alcoholic extract of chicory seeds exhibited immunoactive efficacy through inhibiting the lymphocyte proliferation through the mitogen proliferation assay and MLR (mixed lymphocyte reaction) (Amirghofran et al., 2000). The decoction of root parts of *Cichorium intybus* exerted excellent anti-ulcerogenic activity in experimental animal (Sprague-Dawley rats) (Gürbüz et al., 2002)) and thus displayed the gastroprotective activity of chicory (Street et al., 2013). The aqueous root extract containing bitter compounds (lactucin, lactucopicrin, and the guaianolide sesquiterpenes) was determined as antimalarial components against *Plasmodium falciparum* (Leclercq, 1984;

Bischoff et al., 2014). Condensed tannins and sesquiterpene lactones found in *Cichorium intybus* was determined to show anthelmintic property profoundly in grazing animals (Miller et al., 2011), and also exhibited their effectiveness against nematode larvae, particularly larvae of deer lungworm (*Dictyocaulus viviparus*) and other gastrointestinal nematodes (Molan et al., 2003). The sesquiterpene lactone-rich fraction of chicory extract was also tested to hamper egg hatching of *Haemonchus contortus* (Foster et al., 2011).

CONCLUSION

Cichorium intybus have a long history of traditional uses. Since ancient times, different parts of the plant have been used as a folklore remedy to cure a number of diseases particularly diabetes and liver linked disorders. A vast range of metabolites, particularly secondary metabolites are present extensively in plants and exhibit a number of medicinal activities and have resulted in the reduction and prevention of numerous ailments (Fig. 2). The extracted and isolated 'phytochemical constituents' showing anti-disease activity, which was evaluated on the basis of several experimental studies, validated the indigenous knowledge of chicory for its miscellaneous uses in phytotherapy.

Future Prospects

Application of chicory in phytotherapy is wider, but current challenges are still to be addressed in further evaluation of other undiscovered medicinal properties of this herb. Since *Cichorium intybus* is compliant for genetic manipulation, so the future interest will be for acquiring the new therapeutic potential of plants. Most of the phytoconstituents have not been studied for the therapeutic potential so the future investigation is required to expand systematic understanding of the bioactive compounds against different ailments.

ACKNOWLEDGEMENTS

Support and help provided by friends and colleagues are gratefully acknowledged.

REFERENCES

- Abbas, Z. K., Saggu, S., Sakeran, M. I., Zidan, N., Rehman, H., and Ansari, A. A. (2014). Phytochemical, antioxidant and mineral composition of hydroalcoholic extract of chicory (*Cichorium intybus* L.) leaves. *Saudi Journal of Biological Sciences*, 22(3), 322–326. <https://doi.org/10.1016/j.sjbs.2014.11.015>
- Abdallah, E. M. (2011). Plants: An alternative source for antimicrobials. *Journal of Applied Pharmaceutical Science*, 1(6), 16–20.
- Ahmed, B., Al-Howiriny, T. A., and Siddiqui, A. B. (2003). Antihepatotoxic activity of seeds of *Cichorium intybus*. *Journal of Ethnopharmacology*, 87(2–3), 237–240. [https://doi.org/10.1016/S0378-8741\(03\)00145-4](https://doi.org/10.1016/S0378-8741(03)00145-4)
- Ahmed, B., Khan, S., Masood, M. H., and Siddique, A. H. (2008). Anti-hepatotoxic activity of cichotyboside, a sesquiterpene glycoside from the seeds of *Cichorium intybus*. *Journal of Asian Natural Products Research*, 10(3), 218–223. doi:10.1080/10286020701590764
- Alshaghдали, K., Alharazi, T., Rezgui, R., Acar, T., Aljerwan, R. F., Altayyar, A., Tasleem, M., Saeed, M., Yadav, D. K., & Saeed, A. (2024). Identification and evaluation of putative type 2 diabetes mellitus inhibitors derived from *Cichorium intybus*. *Journal of Molecular Structure*, 1306, 137629.

- Amer, A. M. (2018).** Antimicrobial effects of egyptian local chicory, *Cichorium endivia* subsp. pumilum. *International Journal of Microbiology*, 2018.
<https://doi.org/10.1155/2018/6475072>
- Amirghofran, Z., Azadbakht, M., and Karimi, M. H. (2000).** Evaluation of the immunomodulatory effects of five herbal plants. *Journal of Ethnopharmacology*, 72(1–2), 167–172. [https://doi.org/10.1016/S0378-8741\(00\)00234-8](https://doi.org/10.1016/S0378-8741(00)00234-8)
- Atta-ur-Rahman, Zareen, S., Choudhary, M. I., Akhtar, M. N., and Khan, S. N. (2008).** α -glucosidase inhibitory activity of triterpenoids from *Cichorium intybus*. *Journal of Natural Products*, 71(5), 910–913. <https://doi.org/10.1021/np800001v>
- Azay-Milhou, J., Ferrare, K., Leroy, J., Aubarterre, J., Tournier, M., Lajoix, A., and Tousch, D. (2013).** Antihyperglycemic effect of a natural chicoric acid extract of chicory (*Cichorium intybus* L.): A comparative in vitro study with the effects of caffeic and ferulic acids. *Journal of Ethnopharmacology*, 150(2), 755–760. doi:10.1016/j.jep.2013.09.046
- Bais, H. P., and Ravishankar, G. A. (2001).** *Cichorium intybus* L - Cultivation, processing, utility, value addition and biotechnology, with an emphasis on current status and future prospects. *Journal of the Science of Food and Agriculture*. <https://doi.org/10.1002/jsfa.817>
- Bischoff, T. A., Kelley, C. J., Karchesy, Y., Laurantos, M., Nguyen-Dinh, P., and Arefi, A. G. (2004).** Antimalarial activity of Lactucin and Lactucopicrin: Sesquiterpene lactones isolated from *Cichorium intybus* L. *Journal of Ethnopharmacology*, 95(2–3), 455–457. <https://doi.org/10.1016/j.jep.2004.06.031>
- Bratic, A., and Larsson, N. (2013).** The role of mitochondria in aging. *Journal of Clinical Investigation*, 123(3), 951–957. doi:10.1172/jci64125
- Carazzone, C., Mascherpa, D., Gazzani, G., and Papetti, A. (2013).** Identification of phenolic constituents in red chicory salads (*Cichorium intybus*) by high-performance liquid chromatography with diode array detection and electrospray ionisation tandem mass spectrometry. *Food Chemistry*, 138(2–3), 1062–1071. <https://doi.org/10.1016/j.foodchem.2012.11.060>
- Cavin, C., Delannoy, M., Malnoe, A., Debefve, E., Touché, A., Courtois, D., and Schilter, B. (2005).** Inhibition of the expression and activity of cyclooxygenase-2 by chicory extract. *Biochemical and Biophysical Research Communications*, 327(3), 742–749. <https://doi.org/10.1016/j.bbrc.2004.12.061>
- Cemek, M., Aymelek, F., Büyükkokuroğlu, M. E., Karaca, T., Büyükbek, A., and Yilmaz, F. (2010).** Protective potential of Royal Jelly against carbon tetrachloride induced-toxicity and changes in the serum sialic acid levels. *Food and Chemical Toxicology*, 48(10), 2827–2832. <https://doi.org/10.1016/j.fct.2010.07.013>
- Chandra, K., Khan, W., Jetley, S., Ahmad, S., and Jain, S. K. (2018).** Antidiabetic, toxicological, and metabolomic profiling of aqueous extract of *Cichorium intybus* seeds. *Pharmacognosy Magazine*, 14(57), S377–S383. <https://doi.org/10.4103/pm.pm.583.17>
- Chevallier, A. (1996).** Encyclopedia of medicinal plants, D.K. Publishing Book, New York.
- Chopra, R.N., Chopra, I.C., Handa, K.L., and Kapur, L.D. (1958).** Indigenous Drugs of India, second ed., UN Dhar and sons Pvt. Ltd, Calcutta.
- Conforti, F., Ioele, G., Statti, G. A., Marrelli, M., Ragno, G., and Menichini, F. (2008).** Antiproliferative activity against human tumor cell lines and toxicity test on

- Mediterranean dietary plants. *Food and Chemical Toxicology*, 46(10), 3325–3332. <https://doi.org/10.1016/j.fct.2008.08.004>
- Dalar, A., and Konczak, I. (2014).** *Cichorium intybus* from Eastern Anatolia: Phenolic composition, antioxidant and enzyme inhibitory activities. *Industrial Crops and Products*, 60, 79–85. <https://doi.org/10.1016/j.indcrop.2014.05.043>
- Dalhanacharya. (2009).** *Susruta Samhita*. Jadavaji Trikamji Acharya (eds.). Published by Chaukhambha Orientalia, Varanasi. pp. 158 - 159.
- Das, S., Vasudeva, N., and Sharma, S. (2016).** *Cichorium intybus* : A concise report on its ethnomedicinal, botanical, and phytopharmacological aspects . *Drug Development and Therapeutics*, 7(1), 1. <https://doi.org/10.4103/2394-6555.180157>
- Devdi, L., Morroni, F., Lombardi-boccia, G., Lucarini, M., Hrelia, P., Cantelli-forti, G., and Tarozzi, A. (2013).** Red Chicory (*Cichorium intybus* L. cultivar) as a potential source of antioxidant, anthocyanins for intestinal health. *Oxid Med Cell Longev*.
- Dorostghol, M., Seyyednejad, S. M., and Nejad, M. (2019).** Beneficial effects of *Cichorium intybus* L. extract on oxidative status and reproductive parameters in male Wistar rats: An experimental study. *International journal of reproductive biomedicine (Yazd, Iran)*, 17(6), 425–434. doi:10.18502/ijrm.v17i6.4814
- Ekor M. (2014).** The growing use of herbal medicines: issues relating to adverse reactions and challenges in monitoring safety. *Frontiers in pharmacology*, 4, 177. doi:10.3389/fphar.2013.00177
- Elgengaihi, S., Mossa, A. T. H., Refaie, A. A., and Aboubaker, D. (2016).** Hepatoprotective efficacy of *Cichorium intybus* L. extract against carbon tetrachloride-induced liver damage in rats. *Journal of Dietary Supplements*, 13(5), 570–584. <https://doi.org/10.3109/19390211.2016.1144230>
- El-Hilaly, J., Hmamouchi, M., and Lyoussi, B. (2003).** Ethnobotanical studies and economic evaluation of medicinal plants in Taounate province (Northern Morocco). *Journal of Ethnopharmacology*, 86(2–3), 149–158. [https://doi.org/10.1016/S0378-8741\(03\)00012-](https://doi.org/10.1016/S0378-8741(03)00012-)
- El-Sayed, Y. S., Lebda, M. A., Hassinin, M., and Noeman, S. A. (2017).** Retraction: Chicory (*Cichorium intybus* L.) Root Extract Regulates the Oxidative Status and Antioxidant Gene Transcripts in CCl₄-Induced Hepatotoxicity. *PloS One*. NLM (Medline). <https://doi.org/10.1371/journal.pone.0173587>
- Feroli, F., and D’Antuono, L. F. (2012).** An update procedure for an effective and simultaneous extraction of sesquiterpene lactones and phenolics from chicory. *Food Chemistry*, 135(1), 243–250. <https://doi.org/10.1016/j.foodchem.2012.04.079>
- Foster, J. G., Cassida, K. A., and Turner, K. E. (2011).** In vitro analysis of the anthelmintic activity of forage chicory (*Cichorium intybus* L.) sesquiterpene lactones against a predominantly *Haemonchus contortus* egg population. *Veterinary Parasitology*, 180(3–4), 298–306. <https://doi.org/10.1016/j.vetpar.2011.03.013>
- Gasca, C. A., Cabezas, F. A., Torras, L., Bastida, J., and Codina, C. (2013).** Chemical composition and antioxidant activity of the ethanol extract and purified fractions of cadillo (*Pavonia sepioides*). *Free Radicals and Antioxidants*. doi:10.1016/j.fra.2013.09.00
- Gazzani, G., Daglia, M., Papetti, A., and Gregotti, C. (2000).** In vitro and ex vivo anti- and prooxidant components of *Cichorium intybus*. In *Journal of Pharmaceutical and Biomedical Analysis* (Vol. 23, pp. 127–133). [https://doi.org/10.1016/S0731-7085\(00\)00282-X](https://doi.org/10.1016/S0731-7085(00)00282-X)

- Gewali M. B. (2008).** *Aspects of Traditional Medicine in Nepal*. Published by: Institute of Natural Medicine. University of Toyama, Japan. pp. 2.
- Ghahraman, A. (1994).** Cormophytes of Iran (plant systematics) Tehran Univ. Publ. Cent., 3 (2) pp. 496-517
- Ghamarian, A., Abdollahi, M., Su, X., Amiri, A., Ahadi, A., and Nowrouzi, A. (2012).** Effect of chicory seed extract on glucose tolerance test (GTT) and metabolic profile in early and late-stage diabetic rats. *DARU, Journal of Pharmaceutical Sciences*, 20(1). <https://doi.org/10.1186/2008-2231-20-56>
- Gilani, A.H. and Janbaz. (1994).** Evaluation of the liver protective potential of *Cichorium intybus* seed extract on acetaminophen and CC14-induced damage, *Phytomedicine*, 1(3), 193–197.
- Goyal A. K., Midhha S. K., Sen A. (2013).** Evaluation of DPPH scavenging activity, total phenolic and antioxidant activities in Indian wild *Bambusa vulgaris* “vittata” methanolic leaf extract. *Journal of Natural Pharmaceuticals*. 1 (1): 40- 45.
- Gürbüz, I., Üstün, O., Yeşilada, E., Sezik, E., and Akyürek, N. (2002).** *In vivo* gastroprotective effects of five Turkish folk remedies against ethanol-induced lesions. *Journal of Ethnopharmacology*, 83(3), 241–244. [https://doi.org/10.1016/S0378-8741\(02\)002](https://doi.org/10.1016/S0378-8741(02)002)
- Hazra, B., Sarkar, R., Bhattacharyya, S., and Roy, P. (2002).** Tumour inhibitory activity of chicory root extract against Ehrlich ascites carcinoma in mice. *Fitoterapia*, 73(7–8), 730–733. [https://doi.org/10.1016/S0367-326X\(02\)00232-0](https://doi.org/10.1016/S0367-326X(02)00232-0)
- Heimler, D., Isolani, L., Vignolini, P., and Romani, A. (2009).** Polyphenol content and antiradical activity of *Cichorium intybus* L. from biodynamic and conventional farming. *Food Chemistry*, 114(3), 765–770.
<https://doi.org/10.1016/j.foodchem.2008.10.010>
- Innocenti, M., Gallori, S., Giaccherini, C., Ieri, F., Vincieri, F. F., and Mulinacci, N. (2005).** Evaluation of the phenolic content in the aerial parts of different varieties of *Cichorium intybus* L. *Journal of Agricultural and Food Chemistry*, 53(16), 6497–6502. <https://doi.org/10.1021/jf050541d>
- Jeong, D., Kim, D., Chon1,, J., Kim, H., Kim, H., Song, K., ... Seo, K. (2016).** The Antimicrobial Activity of the Crude Extracts from *Cichorium intybus* L. (Chicory) against *Bacillus cereus* in Various Dairy Foods. *Journal of Milk Science and Biotechnology*, 34(4), 239-244. doi:10.22424/jmsb.2017.34.4.239
- Judžentiene, A., and Budiene, J. (2008).** Volatile constituents from aerial parts and roots of *Cichorium intybus* L. (chicory) grown in Lithuania. *Chemija*, 19(2), 25–28.
- Kaisar M., Rahman M., Rahman M., Hasan C., Rashid M. A. (2013).** A Review on Phytochemicals from Some Medicinal Plants of Bangladesh. *Journal of Pharmacy and Nutrition Sciences*. 1 (4): 87 - 95.
- Katiyar, P., Kumar, A., Mishra, A.K., Dixit, R.K., Kumar, A., Kumar, R., and Gupta, A.K. (2015).** Kasni (*Cichorium Intybus* L.) a propitious traditional medicinal herb. *International Journal of Pharmacognosy*, 2(8):368-80. doi link: [http://dx.doi.org/10.13040/IJPSR.0975-8232.IJP.2\(8\).368-80](http://dx.doi.org/10.13040/IJPSR.0975-8232.IJP.2(8).368-80).
- Kaur, N., and Gupta, A. K. (2002).** Applications of inulin and oligofructose in health and nutrition. *Journal of Biosciences*. Indian Academy of Sciences. <https://doi.org/10.1007/BF02708379>
- Kennedy, D. O., and Wightman, E. L. (2011).** Herbal Extracts and Phytochemicals: Plant Secondary Metabolites and the Enhancement of Human Brain function. *Advances in Nutrition*, 2(1), 32–50. <https://doi.org/10.3945/an.110.000117>

- Khalaf, H. A., El-Saadani, R. M., El-Desouky, A. I., Abdeldaiem, M. H., and Elmehy, M. E. (2018). Antioxidant and antimicrobial activity of gamma-irradiated chicory (*Cichorium intybus* L.) leaves and roots. *Journal of Food Measurement and Characterization*, 12(3), 1843–1851. <https://doi.org/10.1007/s11694-018-9798-0>
- Kim, H. M., Kim, H. W., Lyu, Y. S., Won, J. H., Kim, D. K., Lee, Y. M., ... An, N. H. (1999). Inhibitory effect of mast cell-mediated immediate-type allergic reactions by *Cichorium intybus*. *Pharmacological Research*, 40(1), 61–65. <https://doi.org/10.1006/phrs.1999.0474>
- Kirtikar, K.R. and Basu, B.D. (2006). Indian Medicinal Plant, second ed. International book distributor, India, 1433–1435.
- Lavelli, V. (2008). Antioxidant activity of minimally processed red chicory (*Cichorium intybus* L.) evaluated in xanthine oxidase-, myeloperoxidase-, and diaphorase-catalyzed reactions. *J Agric Food Chem*, 56: 7194–200.
- Leclercq, E. (1984). Determination of lactucin in roots of chicory (*Cichorium intybus* L.) by high-performance liquid chromatography. *Journal of Chromatography A*, 283(C), 441–444. [https://doi.org/10.1016/S0021-9673\(00\)96288-5](https://doi.org/10.1016/S0021-9673(00)96288-5)
- Lee, K. T., Kim, J. I., Park, H. J., Yoo, K. O., Han, Y. N., and Miyamoto, K. I. (2000). Differentiation-inducing effect of magnolialide, a 1 β -hydroxyeudesmanolide isolated from *Cichorium intybus*, on human leukemia cells. *Biological and Pharmaceutical Bulletin*, 23(8), 1005–1007. <https://doi.org/10.1248/bpb.23.1005>
- Li, M., Xie, G., Ding, Y., Ma, J., Liu, Q., Wang, Y., Peng, Z., Sun, J., & Shang, J. (2023). Chemometric discrimination of *Cichorium glandulosum* Boiss. et Huet and *Cichorium intybus* L. via their metabolic profiling, antioxidative, and hypoglycemic activities. *Foods*, 12(4), 901.
- Liu, Y., Wang, Q., Liu, H., Chen, G., and Cui, J. (2011). Applied orthogonal design for filtrating conditions of ultrasonic-assisted extraction from plant-chicory. *African Journal of Biotechnology*, 10(13), 2493–2502. <https://doi.org/10.5897/AJB10.1870>
- Llorach, R., Tomás-Barberán, F. A., and Ferreres, F. (2004). Lettuce and chicory byproducts as a source of antioxidant phenolic extracts. *Journal of Agricultural and Food Chemistry*, 52(16), 5109–5116. <https://doi.org/10.1021/jf040055a>
- Mehmood, N., Zubair, M., Rizwan, K., Rasool, N., Shahid, M., and Uddin Ahmad, V. (2012). Antioxidant, antimicrobial and phytochemical analysis of *cichoriumintybus* seeds extract and various organic fractions. *Iranian journal of pharmaceutical research: IJPR*, 11(4), 1145–1151.
- Meng, X.-H., Lv, H., Ding, X.-Q., Jian, T.-Y., Guo, D.-L., Feng, X.-J., Ren, B.-R., & Chen, J. (2022). Sesquiterpene lactones with anti-inflammatory and cytotoxic activities from the roots of *Cichorium intybus*. *Phytochemistry*, 203, 113377.
- Miller, M. C., Duckett, S. K., and Andrae, J. G. (2011). The effect of forage species on performance and gastrointestinal nematode infection in lambs. *Small Ruminant Research*, 95(2–3), 188–192. <https://doi.org/10.1016/j.smallrumres.2010.09.006>
- Molan, A. L., Duncan, A. J., Barry, T. N., and McNabb, W. C. (2003). Effects of condensed tannins and crude sesquiterpene lactones extracted from chicory on the motility of larvae of deer lungworm and gastrointestinal nematodes. *Parasitology International*, 52(3), 209–218. [https://doi.org/10.1016/S1383-5769\(03\)00011-4](https://doi.org/10.1016/S1383-5769(03)00011-4)
- Mulabagal, V., Wang, H., Ngouajio, M., and Nair, M. G. (2009). Characterization and quantification of health beneficial anthocyanins in leaf chicory (*Cichorium intybus*)

- varieties. *European Food Research and Technology*, 230(1), 47–53.
<https://doi.org/10.1007/s00217-009-1144-7>
- Nandagopal, S., Ranjitha Kumari B.D. (2007).** Phytochemical and antibacterial studies of chicory (*Cichorium intybus* L.)—a multipurpose medicinal plant
- Nashar, M., Yoana D., Kiselova-Kaneva., and Ivanova, D.G. (2019).** Antidiabetic Potential of Plants Used in Bulgarian Folk Medicine and Traditional Diet, Nutrition in Health and Disease - Our Challenges Now and Forthcoming Time, Gyula Mózsik and Mária Figler, IntechOpen, DOI: 10.5772/intechopen.85445. Available from: <https://www.intechopen.com/books/nutrition-in-health-and-disease-our-challenges-now-and-forthcoming-time/antidiabetic-potential-of-plants-used-in-bulgarian-folk-medicine-and-traditional-diet>
- Nayemunnisa, A (2009).** Alloxan diabetes-induced oxidative stress and impairment of oxidative defense system in rat brain: neuroprotective effects of *Cichorium intybus*. *International Journal of Diabetes and Metabolism*, 17(3), 105-109. doi:10.1159/000497681
- Nishimura, H., and Satoh, A. (2006).** Antimicrobial and nematocidal substances from the root of chicory (*Cichorium intybus*). In *Allelochemicals: Biological Control of Plant Pathogens and Diseases* (pp. 177–180). Springer Netherlands. https://doi.org/10.1007/1-4020-4447-x_9
- Nishimura, M., Ohkawara, T., Kanayama, T., Kitagawa, K., Nishimura, H., and Nishihira, J. (2015).** Effects of the extract from roasted chicory (*Cichorium intybus* L.) root containing inulin-type fructans on blood glucose, lipid metabolism, and fecal properties. *Journal of Traditional and Complementary Medicine*, 5(3), 161–167. <https://doi.org/10.1016/j.jtcme.2014.11.016>
- Norbak, R., Nielsen, K., and Kondo, T. (2002).** Anthocyanins from flowers of *Cichorium intybus*. *Phytochemistry*, 60(4), 357–359. [https://doi.org/10.1016/S0031-9422\(02\)00055-9](https://doi.org/10.1016/S0031-9422(02)00055-9)
- Oloyede, H. O. B., Ajiboye, T. O., Komolafe, Y. O., and Salau, A. K. (2013).** Polyphenolic extract of *Blighia sapida* arilli prevents N- nitrosodiethylamine-mediated oxidative onslaught on microsomal protein, lipid and DNA. *Food Bioscience*, 1, 48–56. <https://doi.org/10.1016/j.fbio.2013.03.003>
- Olsen, N. J., Branch, V. K., Jonnala, G., Seskar, M., and Cooper, M. (2010).** Phase 1, placebo-controlled, dose escalation trial of chicory root extract in patients with osteoarthritis of the hip or knee. *BMC Musculoskeletal Disorders*, 11. <https://doi.org/10.1186/1471-2474-11-156>
- Pandey, M. M., Rastogi, S., and Rawat, A. K. S. (2013).** Indian traditional ayurvedic system of medicine and nutritional supplementation. *Evidence-Based Complementary and Alternative Medicine*. <https://doi.org/10.1155/2013/376327>
- Papetti, A., Daglia, M., and Gazzani, G. (2002).** Anti- and pro-oxidant water soluble activity of *Cichorium* genus vegetables and effect of thermal treatment. *Journal of Agricultural and Food Chemistry*, 50(16), 4696–4704. <https://doi.org/10.1021/jf020123y>
- Papetti, A., Daglia, M., Grisoli, P., Dacarro, C., Gregotti, C., and Gazzani, G. (2006).** Anti- and pro-oxidant activity of *Cichorium* genus vegetables and effect of thermal treatment in biological systems. *Food Chemistry*, 97(1), 157–165. <https://doi.org/10.1016/j.foodchem.2005.03.036>

- Papetti, A., Mascherpa, D., Carazzone, C., Stauder, M., Spratt, D. A., Wilson, M., ... Gazzani, G. (2013). Identification of organic acids in *Cichorium intybus* inhibiting virulence-related properties of oral pathogenic bacteria. *Food Chemistry*, 138(2–3), 1706–1712. <https://doi.org/10.1016/j.foodchem.2012.10.148>
- Peña-Espinoza, M., Valente, A. H., Thamsborg, S. M., Simonsen, H. T., Boas, U., Enemark, H. L., ... Williams, A. R. (2018). Antiparasitic activity of chicory (*Cichorium intybus*) and its natural bioactive compounds in livestock: A review. *Parasites and Vectors*. BioMed Central Ltd. <https://doi.org/10.1186/s13071-018-3012-4>
- Petrovic, J., Stanojkovic, A., Comic, L., and Curcic, S. (2004). Antibacterial activity of *Cichorium intybus*. *Fitoterapia*, 75(7–8), 737–739. <https://doi.org/10.1016/j.fitote.2004.05.001>
- Pool-Zobel, B. L. (2005). Inulin-type fructans and reduction in colon cancer risk: review of experimental and human data. *British Journal of Nutrition*, 93(S1), S73–S90. <https://doi.org/10.1079/bjn20041349>
- Preethi, K. C., and Kuttan, R. (2009). Hepato and reno protective action of *Calendula officinalis* L. Flower extract. *Indian Journal of Experimental Biology*, 47(3), 163–168.
- Pushparaj, P. N., Low, H. K., Manikandan, J., Tan, B. K. H., and Tan, C. H. (2007). Anti-diabetic effects of *Cichorium intybus* in streptozotocin-induced diabetic rats. *Journal of Ethnopharmacology*, 111(2), 430–434. <https://doi.org/10.1016/j.jep.2006.11.028>
- Pushparaj, P. N., Low, H. K., Manikandan, J., Tan, B. K. H., and Tan, C. H. (2007). Anti-diabetic effects of *Cichorium intybus* in streptozotocin-induced diabetic rats. *Journal of Ethnopharmacology*, 111(2), 430–434. <https://doi.org/10.1016/j.jep.2006.11.028>
- Rani, P., and Khullar, N. (2004). Antimicrobial evaluation of some medicinal plants for their anti-enteric potential against multi-drug-resistant *Salmonella typhi*. *Phytotherapy Research*, 18(8), 670–673. <https://doi.org/10.1002/ptr.1522>
- Rees, S.B., and Harborne, J. B. (1985). The role of sesquiterpene lactones and phenolics in the chemical defence of the chicory plant. *Phytochemistry*, 24(10), 2225–2231. [https://doi.org/10.1016/S0031-9422\(00\)83015-0](https://doi.org/10.1016/S0031-9422(00)83015-0)
- Rehman, A., Ullah, N., Ullah, H., and Ahmad, I. (2014). Antibacterial and antifungal study of *Cichorium intybus*. *Asian Pacific Journal of Tropical Disease*, 4(S2), S943–S945. [https://doi.org/10.1016/S2222-1808\(14\)60763-5](https://doi.org/10.1016/S2222-1808(14)60763-5)
- Rezagholidadeh, L., Pourfarjam, Y., Nowrouzi, A., Nakhjavani, M., Meysamie, A., Ziamajidi, N., and Nowrouzi, P. S. (2016). Effect of *Cichorium intybus* L. on the expression of hepatic NF- κ B and IKK β and serum TNF- α in STZ-and STZ+ niacinamide-induced diabetes in rats. *Diabetology and Metabolic Syndrome*, 8(1). <https://doi.org/10.1186/s13098-016-0128-6>
- Rizvi, W., Fayazuddin, M., Shariq, S., Singh, O., Moin, S., and Akhtar, K (2014). Anti-inflammatory activity of roots of *Cichorium intybus* due to its inhibitory effect on various cytokines and antioxidant activity. *Anc Sci Life*, 34(1):44-9.
- Rollinger, J., Mock, P., Zidorn, C., Ellmerer, E., Langer, T., and Stuppner, H. (2005). Application of the In Combo Screening Approach For the Discovery of Non-Alkaloid Acetylcholinesterase Inhibitors from *Cichorium intybus*. *Current Drug Discovery Technologies*, 2(3), 185–193. <https://doi.org/10.2174/1570163054866855>
- Rossetto, M., Lante, A., Vanzani, P., Spettoli, P., Scarpa, M., and Rigo, A. (2005). Red chicories as potent scavengers of highly reactive radicals: A study on their phenolic composition and peroxyl radical trapping capacity and efficiency. *Journal of*

- Agricultural and Food Chemistry*, 53(21), 8169–8175.
<https://doi.org/10.1021/jf051116n>
- Rungsung, W., Dutta, S., Das, D., and Hazra, J. (2013).** A brief review on the Botanical Aspects and Therapeutic Potentials of Important Indian Medicinal Plants. *International Journal of Herbal Medicine IJHM*, 1(13), 38–45.
- Said, H. M. (1982).** Diseases of the liver: Greco-Arab concepts. Hamdard Foundation Press, Karachi, 1982, pp. 100-131.
- Sakurai, N., Iizuka, T., Nakayama, S., Funayama, H., Noguchi, M., and Nagai, M. (2003).** Vasorelaxant activity of caffeic acid derivatives from *Cichorium intybus* and *Equisetum arvense*. *Yakugaku Zasshi*, 123(7), 593–598.
<https://doi.org/10.1248/yakushi.123.593>
- Sareedenchai, V., and Zidorn, C. (2010).** Flavonoids as chemosystematic markers in the tribe Cichorieae of the Asteraceae. *Biochemical Systematics and Ecology*.
<https://doi.org/10.1016/j.bse.2009.09.006>
- Schumacher, E., Vigh, É., Molnár, V., Kenyeres, P., Fehér, G., Késmárky, G., ... Garai, J. (2011).** Thrombosis preventive potential of chicory coffee consumption: A clinical study. *Phytotherapy Research*, 25(5), 744–748. <https://doi.org/10.1002/ptr.3481>
- Seto, M., Miyase, T., Umehara, K., Ueno, A., Hirano, Y., and Otani, N. (1988).** Sesquiterpene Lactones from *Cichorium endivia* L. and *C. intybus* L. and Cytotoxic Activity. *Chemical and Pharmaceutical Bulletin*, 36(7), 2423–2429.
<https://doi.org/10.1248/cpb.36.2423>
- Shaikh, T., Mujum, A., Wasimuzzama, K., and Rub, R. (2010).** An overview on phytochemical and pharmacological profile of *Cichorium intybus* Linn. *Pharmacology Online*, 2, 298–307.
- Shaikh, T., Rub, R. A., and Sasikumar, S. (2016).** Antimicrobial screening of *Cichorium intybus* seed extracts. *Arabian Journal of Chemistry*, 9, S1569–S1573.
<https://doi.org/10.1016/j.arabjc.2012.04.012>
- Signoretto, C., Canepari, P., Stauder, M., Vezzulli, L., and Pruzzo, C. (2012).** Functional foods and strategies contrasting bacterial adhesion. *Current Opinion in Biotechnology*, 23(2), 160-167. doi: 10.1016/j.copbio.2011.08.006
- Sinkovič, L., Demšar, L., Žnidarčič, D., Vidrih, R., Hribar, J., and Treutter, D. (2015).** Phenolic profiles in leaves of chicory cultivars (*Cichorium intybus* L.) as influenced by organic and mineral fertilizers. *Food Chemistry*, 166, 507–513.
<https://doi.org/10.1016/j.foodchem.2014.06.024>
- Siwach M., Siwach P., Solanki P. and Gill A. (2013).** Biodiversity conservation of Himalayan medicinal plants in India: A retrospective analysis for a better vision. *Journal of Traditional Knowledge*. 5 (9): 529 - 540.
- Street, R. A., Sidana, J., and Prinsloo, G. (2013).** *Cichorium intybus*: Traditional uses, phytochemistry, pharmacology, and toxicology. Evidence-Based Complementary and Alternative Medicine. <https://doi.org/10.1155/2013/579319>
- Süntar, I., Küpeli Akkol, E., Keles, H., Yesilada, E., Sarker, S. D., and Baykal, T. (2012).** Comparative evaluation of traditional prescriptions from *Cichorium intybus* L. for wound healing: Stepwise isolation of an active component by in vivo bioassay and its mode of activity. *Journal of Ethnopharmacology*, 143(1), 299–309.
<https://doi.org/10.1016/j.jep.2012.06.036>
- Szymonik-Lesiuk, S., Czechowska, G., Stryjecka-Zimmer, M., Słomka, M., Mądro, A., Celiński, K., and Wielosz, M. (2003).** Catalase, superoxide dismutase, and

- glutathione peroxidase activities in various rat tissues after carbon tetrachloride intoxication. *Journal of Hepato-Biliary-Pancreatic Surgery*, 10(4), 309–315. <https://doi.org/10.1007/s00534-002-0824-5>
- Tabata, M., Sezik, E., Honda, G., Yeşilada, E., Fukui, H., Goto, K., and Ikeshiro, Y. (1994).** Traditional medicine in Turkey III. Folk medicine in east anatolia, van and bitlis provinces. *Pharmaceutical Biology*, 32(1), 3–12. <https://doi.org/10.3109/13880209409082966>
- Tchakam, P. D., Lunga, P. K., Kowa, T. K., Lonfouo, A. H. N., Wabo, H. K., Tapondjou, L. A., ... Kuiate, J. R. (2012).** Antimicrobial and antioxidant activities of the extracts and compounds from the leaves of *Psorospermum aurantiacum* Engl. and *Hypericum lanceolatum* Lam. *BMC Complementary and Alternative Medicine*, 12. <https://doi.org/10.1186/1472-6882-12-136>
- Tousch, D., Lajoix, A. D., Hosy, E., Azay-Milhau, J., Ferrare, K., Jahannault, C., ... Petit, P. (2008).** Chicoric acid, a new compound able to enhance insulin release and glucose uptake. *Biochemical and Biophysical Research Communications*, 377(1), 131–135. <https://doi.org/10.1016/j.bbrc.2008.09.088>
- Valko M., Leibfritz D., Moncol J., Cronin D., Mazur M., Telser J. (2006).** Free radicals and antioxidants in normal physiological functions and human disease. *International Journal of Biochemistry and Cell Biology*. 39 (1): 45 -84.
- Wealth of India (1950).** A Dictionary of Indian Raw Materials and Industrial Products, vol. 3, Council of scientific and industrial research, New Delhi, 556–561.
- Wu, Y., Zhou, F., Jiang, H., Wang, Z., Hua, C., and Zhang, Y. (2018).** Chicory (*Cichorium intybus* L.) polysaccharides attenuate high-fat diet induced non-alcoholic fatty liver disease via AMPK activation. *International Journal of Biological Macromolecules*, 118, 886–895. <https://doi.org/10.1016/j.ijbiomac.2018.06.140>
- Xiao, H., Xie, G., Wang, J., Hou, X., Wang, X., Wu, W., and Liu, X. (2013).** Chicoric acid prevents obesity by attenuating hepatic steatosis, inflammation and oxidative stress in high-fat diet-fed mice. *Food Research International*, 54(1), 345–353. [doi:10.1016/j.foodres.2013.07.033](https://doi.org/10.1016/j.foodres.2013.07.033)
- Zafar, R., and Mujahid Ali, S. (1998).** Anti-hepatotoxic effects of root and root callus extracts of *Cichorium intybus* L. *Journal of Ethnopharmacology*, 63(3), 227–231. [https://doi.org/10.1016/S0378-8741\(98\)00087-7](https://doi.org/10.1016/S0378-8741(98)00087-7)
- Zhou, Y., Wen, T., Yang, S., Meng, B., Wei, J., Zhang, J., Wang, L., & Shen, X. (2025).** Sesquiterpene lactones from *Cichorium intybus* exhibit potent anti-inflammatory and hepatoprotective effects by repression of NF-κB and enhancement of NRF2. *Journal of Ethnopharmacology*, 343, 119439.

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