AN OVERVIEW ON PHYTOCHEMICAL AND PHARMACOLOGICAL PROFILE OF *CICHORIUM INTYBUS* LINN

Tauseef Shaikh, Atar Mujum, Khan Wasimuzzama, Rukhsana A Rub *

Department of Pharmacognosy, M.C.E. Society’s Allana College of Pharmacy, 2390, K.B Hidayatullah Road, Azam Campus, Camp, Pune-411001, MS, India.

**Summary**

Chicory, *Cichorium intybus*, (Asteraceae), is a biennial or perennial herb and is a native of Europe and Asia. Chicory is an important foodstuff appreciated for its bitter taste. Ground roasted powder of the roots is mixed with coffee to impart rich flavor and to decrease caffeine content of the coffee formulation. The plant is a good tonic, cooling and is useful in headache, throat inflammation and enlargement of spleen. The extensive research work claims hypoglycemic, antiallergic, antineoplastic, fecal bulking property for the roots of Chicory. Immunostimulation, mutagenic, probiotic, hepatoprotective, antibacterial activity etc are the other pharmacological actions attributed to a wide range of phytoconstituents like sesquiterpene lactones, responsible for bitter taste of the plant, eg: lactucin, lactupicrin; coumarines like cichorin; flavonoids like quercetin 3 galactoside. It also contains, inulin (upto 60%), phlobaphenes, phenolic acids like cichoric acid. The present review summarizes the phytochemical status and pharmacological potential of *Cichorium intybus*.

**Keywords:** *Cichorium intybus*; hypoglycemic; phytochemical behavior; sesquiterpene lactones, coumarines

**Address for correspondence:**
Mrs. Rukhsana A. Rub,
Head, Department of Pharmacognosy,
M.C.E. Society’s Allana College of Pharmacy,
2390, K.B Hidayatullah Road,
Azam Campus, Camp, Pune-411001
MS, India.
Email: hailrukhsar@yahoo.com
Contact No.: +91-9890937888
Introduction

Chicory consists of dried roots and dried above ground parts of *Cichorium intybus* Linn, family Compositeae/ Asteraceae.

*Cichorium intybus* Linn

Chicory is a biennial or perennial herb, native to Europe and Asia and can be easily identified by its terminal and auxillary capituloys of lovely blue, lavender, or occasionally white flowers and spindle shaped taproots.\(^1\)\(^,\)\(^2\) It is one of earliest mentioned plants in recorded literature. Horace mentions it in reference to his own diet, which he describes it as “Me pascunt olivae, me cichorea, me malvae” (As for me, olives, endives, and mallows provide sustenance). Lord monbodo describes the plant in 1779 as the Chicoree” which the French cultivate as a pot herb\(^3\). In the United state chicory root has long been used as a substitute for coffee in prisons\(^4\). The plant is a good tonic; cooling; useful in thirst, headache, opthalmia, throat inflammation, fever, vomotting, diarrhoea, enlargement of spleen etc. Root is the best part of the plant; good stomachic, diuretic, enriches and purifies blood, lessons inflammation and pain in the joints. Leaves are applied topically for the same. The seeds are tonic to the brain, good in biliousness, lumbago and asthma etc.\(^5\)

Phytochemical review

1. The roots of *Cichorium intybus* contain sesquiterpene lactones, inulin (up to 60%), phlobaphenes caffeic acid, cichoric acid, sugar, pactin, fixed oil, choline and reducing sugars.\(^1\)\(^,\)\(^6\)
2. The Leaves contain coumarines; esculetin, cichoriin and sesquiterpene lactones. A new coumarin glucoside ester Cichoriin-6'-p-hydroxyphenyl acetate, was also isolated from chicory leaves along with cichoriin.

3. The flowers too contain cichoriin, along with lactucin, intybin and a colourless crystalline glucoside.

4. The seeds contain inulin, phlobaphenes, reducing sugars etc.

5. Water soluble extract of Cichorium intybus roots showed the presence of Alkaloids, Flavonoids, Tannins and saponins.

6. A diacetyl ester, chicoric acid purified from C. intybus was able to enhance insulin secretion and glucose uptake in L6 muscular cells.
7. A sesquiterpenelactone, lactucin and its derivatives lactucopicrin and 11 beta, 13-dihydrolactucin were found to possess analgesic activity in mice while lactucin and lactucopicrin were found to have sedative properties.\textsuperscript{13}

A sesquiterpene lactone 11 beta, 13-dihydrolactucin was quantified for its bitterness value by ELISA in three different varieties of chicory roots which was found to be in the range of 485 to 1720 mg/kg.\textsuperscript{14,42,50}

8. Two new triterpenoids; 18 alpha, 19 beta-20 taraxasten-3beta, 21 alpha-diol (cichoridiol) and 17-epi-methyl-6-hydroxyangolelensate (intybusoloid were isolated together with 11 known compound lupeol, friedelin, beta sitosterol, stigmasterol, betulinic acid, betulin, betulinaldehyde, syringic acid, vanilic acid, 6,7- dihydroxy coumarin, and methyl-alpha-d-galactopyranoside from the methanolic extract of seeds of \textit{Cichorium intybus}, having good alpha glucosidase inhibitory activity.\textsuperscript{15}
9. The composition of peptic polysaccharides homogalacturonans and rhamnogalacturonan-I (RG-I) in leaf cell wall of chicory were found to be high (about 67%) as compared to cellulose, xyloglucans, heteroxylans, and glucomannans in the leaf lamina while midrib contains high proportion of homogalacturonans, and lower proportion of non peptic polysaccharides. 16

10. Cichosterol, a new phytosterol have been isolated from seed of C. intybus and their structures were determined by using spectral studies. 17 A water soluble enzyme lipooxygenase type III was isolated from C. intybus. The results shown by the biochemical properties, kinetic parameters and carotene bleaching activity revealed that the isolated enzyme was found to be lipooxygenase type III depending upon indication given for soyabean isoenzyme. 18

11. An enzyme Fructane 1 Exohydrolase IIa (1FEH) isolated from Cichorium intybus involved in fructane degradation acts as a strong competitive inhibitor with sucrose while 1-kestose acts as an ideal substrate in complex with 1-FEH. 19

12. Three new guaianolides, Eudesmanolide, magnolialide and guaianolide ixerisoside were isolated from aerial part of Cichorium intybus along with known sesquiterpene lactones. 20,47

13. Five principle volatile components octane, n-nanodecane, pentadecanone, hexadecane and pentylsalicylate have been isolated from aerial parts and roots of Cichorium intybus and analysed by GCMS. 21

14. Two new anthocyanins have been isolated from flowers of Cichorium intybus and identified as delphinidin- 3, 5-di-O-(6-O-malonyl-beta-D-glucoside) and delphinidin-
3-O-(6-O-malonyl-beta-D-glucoside)-5-O-beta-D-glucoside with two known compound delphinidin-3-O-beta-D-glucoside-5-O-(6-O-malonyl–beta-D-glucoside) and delphinidin 3,5- di-O-beta-D-glucoside.22

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1 Delphinidin 3,5-di-O-(6-O-malonyl-b-D-glucoside)
2 Delphinidin 3-O-(6-O-malonyl-b-D-glucoside)-5-O-b-D-glucoside
3 Delphinidin 3-O-b-D-glucoside-5-O-(6-O-malonyl-b-D-glucoside)
4 Delphinidin 3, 5-di-O-b–D-glucoside.

Pharmacological review

1. Water soluble extract of chicory has found to cause reduction in cholesterol uptake in gut-perfused rats, may be due to the increased viscosity of intestinal content, the reason could be presence of inulin in large proportion.25,46,48
2. Water extract of *Cichorium intybus* roots has found to have remarkable antioxidant activity on low density lipoprotein (LDL) oxidation and inhibitory effect on production of thiobarbituric acid reactive substances.24,43,44
3. Triterpenoids isolated from chicory possess a good alpha glucosidase inhibitory activity.15
4. Chicoric acid, isolated from *Cichorium intybus* was found to stimulate insulin release from INS-1E insulin secreting cell line and rat islets of langerhans as well as glucose uptake.12
5. Hypoglycemic activity of ethanolic extract of whole plant of *Cichorium intybus* was studied in STZ induced diabetic rats.A dose of 125 mg/kg was found to posses most potent hypoglycemic activity.25
6. Tannins present in methanolic extract of *Cichorium intybus* leaves were found to enhance glucose uptake and inhibit adipogenesis in 3T3-L1 adipocytes.26
7. Ethanolic extract of chicory roots causes significant inhibition of Ehrlich ascites carcinoma in mice at doses ranging from 300-700mg/kg.27
8. The results obtained from toxicological evaluation of chicory root extract revealed that it had no mutagenic activity in Ames test but was found to be cytotoxic to certain strains of Salmonella at higher doses.

9. The lactucin and its derivatives (lactucopicrin and 11 beta, 13-dihydrolactucin) obtained from ethanolic extract of *Cichorium intybus* leaves were investigated for analgesic and sedative activity. Results of study showed that the lactucopicrin had a potent analgesic activity while lactucin and lactucopicrin were found to have good sedative activity.

10. *Cichorium intybus* was evaluated for anti-inflammatory activity. The ethyl acetate extract of roots produced inhibition of prostaglandin E2 (PGE2) production in human colon carcinoma HT29 cells by inhibition of expression of cyclooxygenase-2 (COX-2) and direct inhibition of COX enzyme activity. The ameliorative effect of ethanolic extract of *Cichorium intybus* was investigated using cisplatin induced nephrotoxicity on rats. The extract was found to reduce nephrotoxicity with no sign of toxicity.

11. Transglucosylases, an enzyme obtained from heads of *Cichorium intybus* was found to convert cichoriin to esculin.

12. Antibacterial activity of chicory root extract was investigated using various solvents. The hexane and ethyl acetate extracts were found to be effective than chloroform and pet ether extracts. Chicory root extract was also found to have potential antifungal activity.

13. Lactucin and lactucopicrin, isolated from *Cichorium intybus* possesses anti-malarial activity.

14. *Cichorium intybus* was found to inhibit mast cell mediated immediate type allergic reactions.

15. The immunotoxicity of ethanolic extract of *Cichorium intybus* was investigated in ICR mice. The results revealed that the immunotoxicity induced by ethanol was restored or prevented by *Cichorium intybus* extract.

16. Esculetin, a phenolic compound obtained from *Cichorium intybus* prevents carbon tetrachloride induced liver damage.

17. Root callus of *Cichorium intybus* have better anti-hepatotoxic effect against CCl4 induced liver damage than natural root extract.

18. Also, seeds of *Cichorium intybus* were successively fractioned with acetone, methanol and water and investigated for hepatoprotective activity using CCl4 and paracetamol induced toxicity in rats. The methanolic fraction exhibited maximum hepatoprotective effect.

**Toxicity**

Chicory extract had no mutagenic activity in the Ames test; although it was cytotoxic to certain strains of salmonella at higher doses with or without metabolic activation. It is also contraindicated to patient with kidney stones since the root is rich in oxalates, people having low blood pressure or with tendency to suffer anemia, It must not be used with gastro duodenal ulcers.
Conclusion

Chicory is one of the most important plants mentioned in different traditional systems of medicine and have been found to have huge pharmacological potential and tremendous scope for its phytochemical research; as suggested in this extensive review on the plant. The review highlights wide range of chemical constituents along with their uses like; inulin, sesquiterpene lactones, phenolics like caffeic acid, chichoric acid, coumarins; esculetin, cichoriin, two new triterpenoids having good alpha glucosidase inhibitory activity. Chicoric acid found to stimulate insulin release whereas esculetin preventing carbon tetrachloride induced liver damage. Thus the plant has great hypoglycemic, hepatoprotective, antioxidant and immunomodulatory potential and the crude extracts or the isolated phytoconstituents of the herb can be exploited for designing effective herbal formulations for aforesaid indications. The areas where still more focus is needed are, pharmacognostic evaluation, enhancement of secondary metabolite production and novel agro-techniques for cultivation of the plant on commercial scale.

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