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Kasani beej *(Cichorium intybus)*: Ayurvedic View, Folk View, Phytochemistry and Modern Therapeutic Uses

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ABSTRACT

Cichorium intybus **is commonly known as Chicory, kasani. It is a recognized medicinal plant that belongs to the** ***Asteraceae*** **family. This plant is a well-known traditional herb used in various medicinal systems like Ayurveda, Unani and Siddha medicinal system to treat variety of diseases ranging from wounds to diabetes. The species is native to the European region (Mediterranean region) but can also grow in the temperate and semi-arid regions. The juice extracted from this plant is used as a traditional remedy to cure uterus cancer and tumors. The plant is well-known for its roots that are used as an additive in coffee as it provides bitterness in taste without the caffeine. It is also reported that the roots of the plant contain 40% inulin and acts as an anti-diabetic agent. Historically, the plant was cultivated by ancient Egyptians as a medicinal plant, vegetable crop, coffee substitute and also used as animal forage.** ***Cichorium intybus*** **contains various phytochemical constituents mainly sesquiterpene lactones, caffeic acid derivatives, inulin flavonoids, alkaloids, phenols, steroids terpenoids and many more. The reported pharmacological properties of the** ***C. intybus*** **plant include hepatoprotective, anti-diabetic, anti-cancerous, anti-inflammatory, analgesic, cardiovascular, antioxidant, antimicrobial, anthelmintic, antimalarial, anti-allergic and gastroprotective activities. In this review article, the medicinal and ayurvedic importance of** ***C. intybus*** **plant along with its phytochemicals are briefly explained.**

Keywords- Chicory, Hepatoprotective, Antidiabetic, Rasapanchak, Ayurveda**.**

I. INTRODUCTION

From ancient times, plants are used for medicinal purposes. The medicinal use of herbal plants is used for 400 years before the common era. It has been reported that almost 400 diverse species of plants were used by Hippocrates for medicinal purposes. The natural products extracted from the plants are used in a traditional medicinal system like Ayurveda, Unani, Chinese and Egyptian since ancient times [1]. Various modern medicines are originated from botanical sources [2]. Plants are also studied in the food sector in order to improve the health of people. The various phytochemicals extracts isolated from the plants are used in pharmaceutical sciences to prepare modern drugs [3]. India is referred as the Medicinal Garden of the world. In Indian Vedas, the clinical use of herbal plants is well described to cure number of ailments [4,5]. In the 21st century, natural products derived from herbal plants represent more than 50% of all drugs that are used clinically. It is also reported that almost 7500 plant species are used by local and rural communities of India to treat variety of diseases. Herbal treatment is considered as the primary treatment in the traditional medicinal system of India [6].

Cichorium intybus is commonly known as chicory, kasani is a perennial herb that belongs to the family *Asteraceae* and is cultivated world widely. The species is native to the European region (Mediterranean region) but can also grow in the temperate and semi-arid regions [7]. The name *Cichorium intybus* is derived from Greek and Latin. *Cichorium* means 'field' and intybus meaning 'to cut', because of the leaves, and partly from Latin tubus to indicate the hollow stem [8]. C. intybus is grown for its wide applications and is divided into four categories as per its use: (1)'industrial' or 'root' chicory, which is grown in India, South Africa, northwestern Europe and Chile that produces strong taproot for inulin extraction or coffee substitute. (2) 'Brussels' or 'witloof' chicory that is mainly grown in the European region as industrial chicory for etiolated buds (chicons) by force. (3) 'leaf' chicory is utilized as cooked as fresh or cooked vegetables. (4) 'forage' chicory which is commonly found along roadside and waste areas is used since the mid-1970s as a forage for livestock [9]. It is considered as the most important herbal plant in the Ayurveda, Unani and Siddhamedicinal system to treat variety of diseases. The plant is well-known for its roots that are used as an additive in coffee as it provides bitterness in taste without the caffeine. It is also reported that the roots of the plant contain 40% inulin and acts as an anti-diabetic agent [10]. *C. intybus* is used as an appetizer and is also used to treat diseases like fever, hepatic failure, diarrhea, cough, cancer, hangover, liver disorders, jaundice, gallstones, mild state of chronic skin diseases and other digestive

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problems [11,12,13]. Historically, the plant was cultivated by ancient Egyptians as a medicinal plant, vegetable crop, coffee substitute and also used as animal forage. Various studies reported that the chicory plant contains important chemical constituents such as caffeic acid derivatives, inulin, flavonoids, polyphenol and fructooligosaccharides [14]. *C. intybus* reported to have anti-diabetic [15,16], gastro protective, cardiovascular, anticancer, anthelmintic, antimicrobial, analgesic anti-inflammatory [17], anti-oxidant and ant hepatotoxic properties [18,19]. The chicory plant is known by various names in different countries and states of India (table no. 1)

Table 1: Vernacular names of *C. intybus* [20,21,22]

Arabic	Shikoryah, hidaba, hindaba bariah, Indyba
Chinese	Ju ju
English	Belgium endive, chicory, coffee chicory, French endive, succor, witloof
France	Chicon, chicoree a café, chicoree de, bruxelles, chicoree sauvage, endive, endive, endive witloof, witloof
German	Chicoree, Fleischkraut, Kaffeezichorie, Salatzichorie, Wegwarte, wurzelzichorie
Italian	Cicoria, radicchio
Japanese	Kiku nigana
Spanish	Achicoria de Bruselas, achicoria de café, achicoria de raiz
Swedish	Cikoria
California	Chicory
Greek	Kikori
Gujrat	Kasani
Hindi	Kasni
Punjabi	Hand, Gul
Tamil	Kasni, Tsikorie, Kashini virai
Telugu	Kasini vittulu

Figure 1: *Cichorium intybus (chicory plan)*

Table 2: Taxonomical Classification of *Cichorium intybus* [23,24]

Taxonomical Rank	**Taxon**
Kingdom	Plantae
Sub Kingdom	Tracheobionta
Division	Magnoilopsida
Class	Magnoilopsida
Subclass	Asteridae
Order	Asterales
Family	*Asteraceae / Compositae*
Sub-family	*Cichorioideae*
Genus	*Cichorium*
Species	*Cichrium intybus L.*
Common name	Chicory

II. GENERAL DISTRIBUTION

A. Botanical description of C. intybus

Cichorium intybus commonly known as chicory is a woody perennial herb that belongs to the family *Asteraceae*. This herb is tall, erect that reaches up to the height of 40-110 cm and has a strong taproot system [25].

Parts of plant

***Stem**:* The stem is long, elongated, branched, erect, solitary, sub glabrous that grows up to 30-120cm in height. It has a bright blue flowers. The stem appears less or more hairy, grooved and sturdy when the plant starts to bloom [26].

Leaves: Leaves present are stalked, large, basal, stiff, broadly oblong, tapering, lanceolate or oblanceolate,15-34 × 2-4cm, compact at the base forming a rosette of 30-70 leaves arranged spirally on the stem. The lower leaves are long, pinnately lobed and covered with hairs. while the upperleaves (1-12× 7-30) are smaller and amplexicaul [27].

***Flower**:* Chicory flowers are large, light bluish or purple or lavender and rarely white or pink and have involucre bracts, the outer is shorter and spreading while the inner bract is erect and longer. Flowering starts in July until October [28].

Roots: Roots are fleshy, tapering, white from inside and brownish-yellow from outside and are well developed containing thin bark. The central part is well developed containing numerous vessels that are a part of the xylem [29,30].

Seeds: Seeds present are ovoid, pointed apex, 2.5mm long and have a brownish tip. Seeds mature 20 days after pollination [31].

Fruit: Fruits are 3mm long and 2mm broad, dry, indehiscent and crowned with a ring of long pappus (0.5mm) usually white but sometimes half white and half straw-colored [32].

B. Geographical Distribution of C. intybus:

Chicory is originated from Europe (Mediterranean region) and also distributed in temperate and semi-arid regions such as southwestern Asia and some parts of South Africa, the USA, Australia and North America [33]. Other Kasani growing countries are Baluchistan, Belgium, Europe, India, France, Germany, Persia, Netherlands, Switzerland, South Africa, Waziristan, West Asia, United Kingdom, Siberia, Turkey, North and Central China, New-Zealand and Madagascar [34,35]. In India, it is distributed in Northwest states of Punjab, Kashmir, Andhra Pradesh, Karnataka and Maharashtra. It can grow in almost every type of soil and grows up to the height of 6000 feet in India [36,37].

III. PHYTOCHEMICAL CONSTITUENTS OF *CICHORIUM INTYBUS*

C. intybus plant contains several chemical constituents that are present in all the parts of the plant. Compounds like Sonchuside A, Cichoriolide, Chlorogenic acid, 3,5- Dicaffeolyquinic acid, 4,5Dicaffeolyquinic acid, Crepidiaside A, Cichoralexin, Malic acid, Caffeic acid, 3-Caffeoylquinic acid, 5-Caffeoylquinic acid, 4-Caffeoylquinic acid, Dicaffeoyltartaric acid, (chicoric acid), Cyanidin, Glucoside are identified in chicory plant [38,39,40,41,42,43,44,45]. The root part contains major phytochemicals when compared to its leaves, flower and seed. The structures of some major phytochemicals are shown below in figure 2.

Root: According to various reports the fresh root of *C. intybus* plant contain 68% of inulin (a polysaccharide similar to starch), 14% sucrose, 5% cellulose, 6% protein, 4% ash and 3% other constituents [46,47,48]. It was also reported by the researchers that dry root extract of the *C. intybus* plant contains 98% inulin and 2% other chemical constituents [49]. Soobo (2005) also noted that chicory root mainly contains inulin-type fructan and oligofructose [50]. Sesquiterpenes lactones like sonchusides A and C, and, cytokinin, crepidiase B, cichoriolide A, cichoriosides B and C, ribosylzeatin a nucleotidsugar, lactucopicrin, uridine-5'-diphosphoglucose and chlorogenic, neochlorogenic, 8-deoxylactucin, isochlorogenic, lactucin, caffeic and chicoric acids, fatty acids (mostly palmitic and linoleic), triterpenes are also found in the root extract of chicory plant [51]. The carbohydrates present in root extract contain glucofructosans besides glucose, fructose, taraxarcine, dextrose and levulose. The inulin constituent is converted into inulide and then into fructose because of the presence of inulocoagulase enzyme when stored. Roots also produces a bitter compound composed of lactucopictin, lactucin, cichorin, intybin, tannins, taraxasterol(α-lactucerol), pectin, fructose, alkaloids and fixed oils [52]. Umbelliferone, scopoletin, esculetin, esculin, lactucopicrin, cichoriin and 6,7-hydroxycoumarin are bitter substances present in the root extract of the plant. Glucoside of fructose and catechuic acid are considered probably as the bitter principle [53]. Also, stearin, mannites, tartaric acids are present in a small concentration in the juice of the roots along with betaine and choline. The reported study demonstrated that the roasted roots of the *C. intybus* plant contain 2- acetylpyrrole, furfural, phenylacetaldehyde, vanillin, phenylacetic acid, pyrazines, benzothiazoles, aromatic hydrocarbons, aldehydes, organic acids, phenols, furans, harmane and norharmane [54].

Seed: Seeds of the *C. intybus* plant contain 4.7% of oil, carbohydrates, glycosides, flavonoids, saponins, gums and fatty acids [55]. Fatty acids are composed of saturated (21.7%) and unsaturated (78.3%) fatty acids that contain linoleic acid, monosaturated oleic acid, stearic acid and palmitic acid [56,57]. Chicory seeds also contain a high amount of crude protein, essential amino acids like methionine, lysine, leucine, isoleucine, phenylalanine, saturated and unsaturated demulcent oil. The essential minerals extracted from the roots of *C. intybus* plant are potassium, calcium, magnesium, selenium and zinc which possess hepatoprotective activity when experimented in rats against tetrachloride induced hepatic damage [58,59,60].

Leaves: Tannins, saponins, flavonoids are the phytochemicals isolated from the leaf part of chicory plant. Also, the leaves of *C. intybus* are a good source of phenols, calcium, phosphorus, potassium, vitamin A and vitamin C [61].

Flower: The flower of chicory plant contains anthocyanin that contributes to the blue color of the perianth, saccharides, flavonoids, cichorine, essential oils and methoxycoumarin [62,63,64]. Two new anthocyanins isolated from the flower are delphinidin 3, 5-di-O-(6- O-malonyl_beta glucoside) and delphinidin 3- O_ (6-O-malonyl- beta -D-glucoside) [65]. It also contains more than 10% of total polyphenols out of which the most dominant one is dicaffeoylquinic acid (71% of total polyphenol) that possesses antioxidant and anti-hyperlipidemia property. Vitamins and minerals makes it a laxative and bitter tonic [66].

IV. THE TRADITIONAL AND MODERN VIEW

a) Folk uses

Therapeutic plants have been used by different cultures and communities to meet their primary health care needs. *C. intybus* is primarily cultivated by ancient Egyptians for medicinal usage, vegetable crop, coffee substitute and sometimes for animal forage [67,68,69,70]. It was further cultivated by Greeks and Romans as a vegetable crop 4000 years ago. The therapeutic use of the plant has a long history of its use in the areas where it has been indigenous and the areas where it has been introduced. The widespread use of the chicory plant can be estimated by its different folkloric groups.

The different formulations prepared from this plant are used to treat various diseases and their symptoms. The juice extracted from this plant is used as a traditional remedy to cure uterus cancer and tumors [71]. In South Africa, the leaves, stem and roots of the plant are made into a tea to treat jaundice. It is also used as a tonic and purifying drug for infants although the plant is considered as a weed [72]. In turkey, the ointment prepared from the leaves of the chicory plant is used to treat wound healing [73]. In India, the whole chicory plant is used to cure diabetes, seeds are used to treat liver disorders, and root part is used in the treatment of jaundice, gout, liver enlargement and rheumatism [74,75]. As per the European monograph, chicory roots are used to treat digestive diseases like flatulence, slow digestion, the feeling of abdominal fullness, loss of appetite [76]. The flowers of the chicory plant are used as a tonic and appetite stimulant to treat gallstones, gastro-enteritis, sinus problems, cuts and bruises [77]. In Bosnia and Herzegovina, the aerial parts of the plant are used to treat liver diseases [78]. Inulin, an active constituent present in the chicory plant is helpful in weight loss, constipation, and improves bowel functions [79]. Aqueous extracts of roots were used as light-sensitive plant remedies for malaria as per records [80]. It is an excellent bitter tonic for the liver and also used in urinary tract disorders [81]. Also, it was used to treat severe swelling of the body, tuberculosis, abdominal cramps, hemorrhoids, sore throat, migraine, severe headache, melancholy, deafness and rashes [82].

b) Cichorium intybus in Ayurveda

Chicory plant or Kasni is considered as one of the most important herbal plants in the Ayurveda and Unani medicinal system. *C. intybus* is well known for its roots and is used mainly in coffee substitute and carry various nutritive properties. In Ayurveda medicinal system, it is used to balance pitta and used to cure gall bladder stones by excreting them out of the body. There are various formulations made from Kasani beej that is used as a tonic and used to treat various liver disorders. Kasani is also used to strengthens the bones by absorbing calcium and helps to manage osteoarthritis. In Ayurveda, Unani and Siddha medicinal system it is used to treat hepatobiliary, liver disorders, jaundice, hepatitis and renal disorders. The ayurvedic properties of chicory plant is shown in table no. 3.

Table 3: Rasapanchak (Properties) of *Cichorium intybus*

Rasa	Katu/ bitter, Tikat/ astringent
Guna	Laghu / light, Ruksha / dry
Virya	Ushna / heating
Vipak	Katu / bitter

Action and Properties of Cichorium intybus

Dahprashanan: It is used in reducing the burning sensation.
Shothahara: It is used to cure edema.
Nidrajanan: It helps in inducing sleep.
Deepan: It acts as an appetizer.
Yakritutejak: It helps to stimulate liver functioning.
Trishananigrah: It reduces thirst.
Hridya: It is used in the treatment of heart disorders.
Raktashodhaka: It acts as a blood purifier.
Mutrala: It shows a diuretic effect.
Attvajanan: It promotes reproductive health.
Taapkram: It acts as an antipyretic.

Modern view:

The primary issue which is faced by the Global herbal drug industry in today's scenario is the practice of making these drugs adulterated which is the reason why people have lost their faith in these herbal drugs. [83,84,85,86,87,88] Adulteration can be either intentional or unintentional. In today's time, intentional adulteration is practiced in many different ways like by substituting standard commercial variety, by substituting superficially similar but inferior drugs, by substituting artificially manufactured drugs, the substitution of exhausted drugs, by substituting toxic materials. These practices ultimately degrade the quality of the original drugs. The herbal plant vendors use these adulteration techniques so smartly that these remain undetectable until and unless examination on a microscopic level and chemical level is implied. [89,90,91] The major disadvantages associated with adulteration are deterioration and degradation of drugs. It increases the cost of drugs and produces adverse effects. Adulterated drugs may also have slow actions. [92] The traditional herbal drugs and their formulations are associated with negligible toxicity and are free from adulteration. Central Council for Research in Ayurveda has mentioned its preliminary guidelines for standardization for herbal medicinal formulations [93]. *Cichorium intybus* plant has the best hepatoprotective property and is used in the treatment of liver disorders. So instead of using allopathic medicines, we should prefer herbal medicines as they cure the disease by using holistic approach.

V. PHARMACOLOGICAL AND THERAPEUTIC USES

Chicory plant is a significant herbal plant which carries great medicinal properties. Various clinical and experimental studies evaluate the therapeutic importance of chicory plant in the field of medicines. Some of the important pharmacological properties of chicory plant are described below.

Hepatoprotective activity

The ethanolic extract of chicory when administered orally, showed significant hepatoprotective activity by reducing overactive liver enzymes (aspartate transaminase and alanine transaminase) when taken at dosage 6-18 and 54mg/ kg BW per day [94].

The methanolic and aqueous extract of the *C. intybus* plant was studied against acetaminophen and

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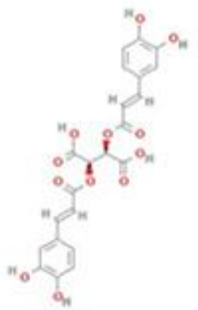
CCl_4 induced hepatic damage in mice model. It was found that acetaminophen produced a 100% mortality rate at 1g/kg dosage while pretreatment of mice with plant extract reduces the death rate up to 30% [95]. Another study was carried out in rats where jigrine (formulation of *C. intybus*) experimented for its hepatoprotective activity against galactosamine-induced hepatopathic rats. It was found that jigrine reduced the level of urea, aspartate transaminase, alanine transaminase and increased blood and tissue glutathione level in male Wistar-albino rats [96].

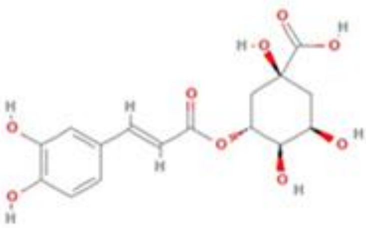
Histopathological study of the liver demonstrated that pretreatment with jigrine reduced the galactosamine toxicity and caused a marked decrease in an inflamed cell. The aqueous extract of roots and root callus when administered orally showed hepatoprotective effect [97].Hydroalcoholic extract of *C. intybus* plant also showed hepatoprotective activity when tested against hydrogen peroxide-induced toxicity in HepG2 cells by significantly hindering the increase in plasma activities of AST, ALT, and ALP concentration [98].

Antimicrobial effect

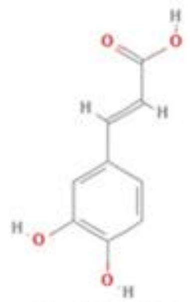
The organic-rich extract of fresh red chicory was tested against *Streptococcus mutans,Actinomyces naeslundii* and *Prevotella intermedia* for antimicrobial activity. Oxalic acid, succinic acid, quinic acid and shikimic acids were identified in the active extract of chicory plant decreased the biofilm formation and bacteria adhesion to the cell with different levels of efficacy. Biofilm disruption and detachment of dead cells for cultured substratum were also induced by these compounds [99].In another study, the crude aqueous extract, root extract and organic seed extract of chicory.



a) Chicoric acid



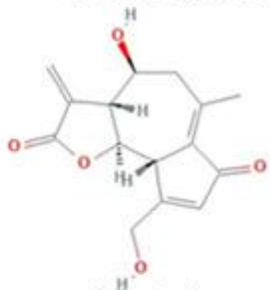
b) Chlorogenic acid



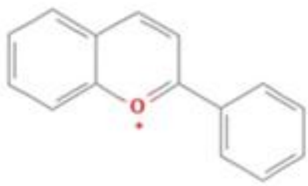
c) Caffeic acid

d) Cyanidine

e) Cichoralexiin

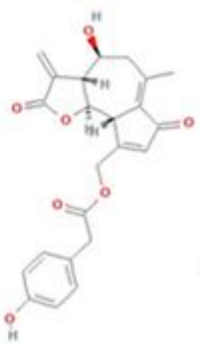


f) Lactucine

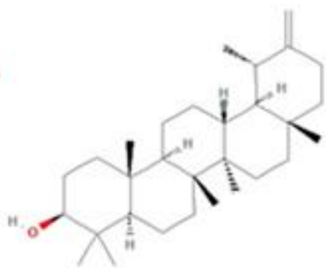


g) Anthocyanine

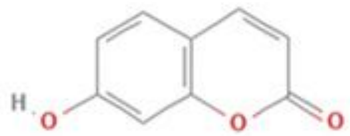
h)Levulose



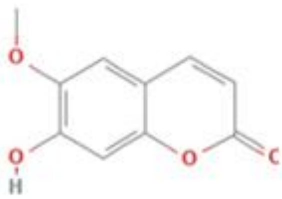
i) Intybin



j)Taraxasterol



k) Umbelliferone



l) Scopoletin

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m) Pectin **n) Inulin** **o) Delphinidine**

Figure 2: Chemical structures of some major phytochemicals structures of *Cichorium intybus* plant.

By these compounds [99].In another study, the crude aqueous extract, root extract and organic seed extract of chicory plant were also found to have antimicrobial activity when tested against *Staphylococcus aureus*, *Pseudomonas aeruginosa*, *Escherichia coli* and *Candida albicans* [100,101]. Also, Guainolides- rich root extracts of the *C. intybus* plant showed antifungal properties when tested against anthropophilic fungi *Trichophyton tonsurans*, *T. rubrum* and *T. violaceum* [102].

Among all root extracts of the *C. intybus* plant, ethyl acetate showed strong antibacterial activities against *Staphylococcus aureus*, *Pseudomonas aeruginosa*, *Escherichia coli* and *Candida albicans*. Although, *C. intybus* seeds showed poor antifungal activity and mild antibacterial activity [103].

Antimalarial effect

The aqueous root extract of the *C. intybus* plant contains bitter compounds named lactucin, lactucopicrin and guinanolide sesquiterpenes which showed antimalarial activity by inhibiting HB3 clone of strain Honduras-1 of Plasmodium falciparum when given at 10 and 50 µg/mL of dosage [104,105].

Anthelmintic activity

Reported studies revealed that secondary metabolites present in *C. intybus* plant showed anthelmintic activity when tested on grazing animals. It was also found that animals grazing on chicory has a high-performance index and a lower incidence of gastrointestinal nematode infestation. Condensed tannins and sesquiterpene lactones found in the Chicory plant showed anthelmintic property [106]. Also, sesquiterpene lactone-rich extract of the C. intybus plant was responsible for inhibiting egg hatching of *Haemonchus contortus* [107].

Antioxidant activity

The *in vitro* study was conducted against rat liver cell microsome lipid peroxidation to find out the antioxidant property of the plant. It was found that the methanolic and ethyl acetate extract of seeds of the chicory plant showed strong antioxidant property [108,109].

Gastroprotective activity

The aqueous root extract of the plant showed gastroprotective property when given orally to Sprague-Dawley rats, 15 minutes before the induction of ulcer genesis by ethanol. Results showed 95% inhibition of ulcer genesis in the test group [110].

Analgesic activity

To test the analgesic activity of *C. intybus* plant, Lactucin, lactucopicrin and 11β, 13-dihydro-lactucin was injected in mice in the hot plate and tail flicks test. It was found that lactucopicrin showed remarkable analgesic activity in the hot plate test. Also, lactucin and lactucopirin showed some sedative actions when tested in mice [111].

Anti-inflammatory activity

The root extract of the plant was tested against the human colon carcinoma (HT 29) cell line to determine the anti-inflammatory property of the *C. intybus* plant. It was found that the ethyl acetate extract of the chicory plant inhibits the formation of prostaglandin E2(PGE2) in a dose-dependent manner and also suppresses TNF-alpha mediated induction of COX-2 expression [112].

Anti-allergic activity

The *in vivo* and *in vitro* study was conducted in mice to identify the anti-allergic effect of *C. intybus* plant. Results showed that the aqueous extract of the chicory plant inhibited the mast cell-mediated allergic reactions immediately in a dose-dependent manner. It also inhibited passive cutaneous anaphylactic reaction caused by anti- dinitrophenyl IgE in rats [113].

Anti-cancerous activity

The crude ethanolic extract of *C. intybus* roots showed inhibition of Ehrlich tumor carcinoma when tested in mice [114]. Also, the aqueous-alcoholic extract isolated from chicory leaves showed a significant anti-proliferative effect when tested in amelanotic melanoma C32 cell line 94 [115].

Appetizer effect

It was reported that chicory leaves and roots contain inulin and fructooligosaccharides that increase the viscosity of stomach content slow down the rate of gastric emptying of water, nutrients and water [116]. Also, root and leaf extract of chicory plant acts as an appetizer, cholagogue, depurative, digestive hypoglycemic, laxative and tonic. Also, Inulin isolated from the roots and leaves of the chicory plant showed significant effects on body weight and fat mass development [117].

Cardioprotective activity

The aqueous leaf extract of the *C. intybus* plant was tested against the aging myocardium of albino rats to determine the cardioprotective activity of the plant [118]. It was found that extracts of Kasani leaf showed protection of the heart against oxidative damage and improve age-induced injury [119].

Hypoglycemic and Hypolipidemic activity

The ethanol extract of the *C. intybus* plant was examined for hypoglycemic and hypolipidemic activity. The test was conducted in diabetic male Sprague-Dawley rats. It was found that ethanolic extract when administered orally at 125mg/kg dose weaken the serum glucose level in the glucose tolerance test. The decrease in cholesterol and serum triglycerides was also observed in the rat model [120]. Another study was conducted in male Wistar albino rats induced with early and late stages of diabetes. Results showed that the aqueous seed extract of the plant inhibit weight loss in both early and late-stage diabetic rats and chicory treated diabetic animal oppose an excessive increase in fasting blood sugar [121].The leaf powder of the *C. intybus* plant when injected in Wistar rats showed a decrease in glucose level near normal value [122]. Table no. 4 represents the pharmacological properties of *C. intybus* plant

Table 4: Reported pharmacological studies of various extracts of *C. intybus* plant.

S. No.	Extract	Method / Model	Pharmacological activity	Reference
1.	Methanolic, aqueous, hydro alcoholic, ethanolic	Mice, Wistar albino rats HepG2 cells of liver (clinical study)	Hepatoprotective	[94][95][96][97][98]
2.	Crude aqueous, ethyl acetate, organic seed extract	*Streptococcus mutans, Actinomyces naeslundii, Prevetella intermediate, Pseudomonas aeruginosa, E. coli, Candida albicans, Trichophyton tonsurans, T. rubrum, T. violaceum*	Antifungal, Antimicrobial	[99][100][101][102][103]
3.	Aqueous root extract	*Plasmodium falciparum*	Antimalarial	[104][105]
4.	Sesquiterpene lactone rich extract	Grazing animals	Anti-helminthic	[106][107]
5.	Methanolic and ethyl acetate	Rat liver cell and Human colon carcinoma HT29 (clinical study)	Antioxidant, Anti-inflammatory	[108][109][112]
6.	Aqueous extract	Sprague-Dawley rats, mice	Gastroprotective, anti-allergic	[110][113]
7.	Lactucin, Lactucopicrin	Mice (hot plate test and tail flick test)	Analgesic, sedative	[111]
8.	Crude ethanolic extract, aqueous alcoholic extract	Mice, amelanotic melanoma C32 cell line 94	Anti-cancerous activity	[114][115]
9.	Root and leaf extract	-----	Appetizer	[116][117]
10.	Aqueous leaf extract	Albino rats	Cardio protective	[118][119]
11.	Ethanolic and aqueous seed extract	Male Wistar albino rats, diabetic Sprague-Dawley rats,	Antidiabetic	[120]121][122]

VI. TOXICITY

Kasani has been used since ancient times for medicinal purposes. Beside this, the higher level of secondary metabolites extracted from the *C. intybus* plant showed toxicological effects. To identify the safety of the roots of the *C. intybus* plant, a sub-chronic toxicity assessment test and Ames test were conducted. For potential mutagenic property, the sesquiterpene-rich extract was estimated using *Salmonella typhimurium* strains TA97a, TA98, TA100 and TA1535 and *E. coli* strain WP2 uvrA. Though mutagenicity was not observed but cytotoxicity was observed at high extract doses in some strains. The oral toxicity study for 28 days was carried out in CRL: CD (SD) IGS BR rats showed no extract-related mortality or any other signs of toxicity [123]. Also, the leaf extract showed no toxic effects at acute or sub-chronic toxicity level when experimented in the rat model. Chicory extract is observed as safe by FDA for human use but the edibility of chicory seeds and their toxicity is yet to be determined [124].

VII. CONCLUSION

Cichorium intybus has been used since ancient times for medicinal purposes by traditional and other rural communities as a primary healthcare practice. The plant is well-known for its roots that is used as a coffee substitute and are widely used to treat a variety of diseases. This plant has a rich history of use in folklore as indicated by its different folk names. The current review focuses on the medicinal importance of the plant both in Ayurveda and modern science. Reported pharmacological properties of *C. intybus* plant include hepatoprotective, anti-diabetic, anti-cancerous, anti-inflammatory, analgesic, cardiovascular, antioxidant, antimicrobial, anthelmintic, antimalarial, ant allergic and gastro protective activities. There are several phytochemicals present in the *C. intybus* plant that are yet to be explored in the field of development and need more research and clinical studies to increase their efficiency and importance in modern sciences.

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