CHAPTER 2
LITERATURE REVIEW

2.1 Lepidium sativum L

2.1.1 Plant Profile of Lepidium sativum

<table>
<thead>
<tr>
<th>Botanical Name</th>
<th>Lepidium Sativum Linn</th>
</tr>
</thead>
<tbody>
<tr>
<td>Genus</td>
<td>Lepidium</td>
</tr>
<tr>
<td>Species</td>
<td>Sativum</td>
</tr>
<tr>
<td>Family</td>
<td>Cruciferae</td>
</tr>
<tr>
<td>Vernacular names</td>
<td>Chandrasura, Garden Cress, Chansaur, Halim Asaliya, Ahera.</td>
</tr>
</tbody>
</table>

2.1.2 Description of Lepidium sativum
Datta and Datta (1961) The plant of Lepidium Sativum is a culinary source and is sown in whole Asian continent for its cuisine property. In India it is used for salad purpose. It is 15-45 cm long with glabrous and herbaceous characteristics. Lepidium Sativum has very versatile leaves either fully lobed or sparingly lobed with or without pinnatisect, some leaves are radical in nature with petioled, or double pinnatisect, some leaves are cauline, straight or pmnatified. The plant bears small white flowers with smaller pod which is epiliptical or oval, with apex wings. The seeds are reddish brown in color with dimensions about 2-3 mm in length and 1-1.5 mm in width, they are oval in shape with point at one end giving triangular shape with covering of furrows on either side. When they are kept overnight in water the coats get swelled with a transparent cover of mucilage. 0.15 to 0.22 g of seeds crosses ponds to 100 seeds.

2.1.3 Pharmacognostical and Phytochemical Review of Lepidium sativum
Nadkarni and Nadkarni (1954) According to Nadkarni et al the seeds posses anti diarrheal and anti dysentery and is also used in treatment of hiccough and skin disease when decoction or cold infusion of seeds is consumed. Their work also states that the seeds emulsion of this plant in boiling water in a dose of half to one ounce can completely cure the hiccough giving its maximum benefit for it. it is further reported by them it can be used for enlarge spleen and can also cause abortion in when boiled with milk. The mixture of fine sugar and powder seeds is good for indigestion, diarrhoea and dysentery. General debility in household preparation is often curing when the seeds are consumed with, ghee and sugar. The seeds also behave like nutrious tonic when boiled in milk for nursing mothers thus increasing the secretion of milk and relieving the flatulence.
Kirtikar and Basu (1984) Kirtikar and Basu research is based on its raw preparation especially when consumed in form of salad. The leaves are used for garnishing and sometimes cooked with vegetable to get their maximum benefit. Horses and camels use this plant for its food property or fodder. Bleeding piles, Asthma and cough, further liver complains scorbutic diseases can also be treated with this plants Secondary syphilis and tenesmus can be treated with roots of this plant. Diuretic, Galactogogue, rubefacient, laxative, aphrodisiac emmenegogue and tonic properties are also associated with leaves.

Varadarajan (1985) Varadarajan et al reported the oil content obtained from the seeds of this plant with 25.5% yield of brownish yellow color having pungent odor and can give the burning sensation with a soap preparation. The oil contains both saturated and unsaturated acids in the following percentage behenic, 1.73, palmitic, 1.27, arachidic, 1.54, stearic, 6.01, hnonenic acid, 28.0 lignoceric, 0.2 and oleic, 61.25.3 sitosterol (1830 pg/g oil) and tocopherol are the unsaponifiable matter. Uronic acid containing polysaccharides and cellulose (18.3%) are the seed mucilage in a mixture. Acid hydrolysis yields L-rhamnose, L-arabinose, D-glucose, D-galactose and Dgalactouromc acid.

Maier et al (1998) Maier and co-workers studied the dimeric imidazole alkaloid mainly Lepidine B, C, D, E and Fin seeds of this plant with semilepidmoside A and B as monomeric imidazole alkaloids.

Datta and Datta(1961) Datta and Datta revealed endosperm is not with embryo but it is absorbed with embryo with a seed coat called exalbuminous. There are three layers of cells on seeds, outer most layers contains mucilage. The middle layer is of sclerenchymatous with thick-walled cells and inner most layers contain collapsed cells. Soaking of seeds in water makes the swelling of outer layer with development of finger-like laminate of mucilage, protruding from inner layer.

Prajapati et al (2003) Lepidium sativum chemically contains, flavanoids, alkaloids, saponins, carbohydrates, proteins, sterols, anthracene glycosides, amino acids, as main phytochemical constituents, further Prajapati et al also reported the pharmacological activity of its seed extracts for hypotensive, anti-microbial, bronchodilator and hypoglycemiec.

Huang et al (2015) Huang and co-workers studied the adaptation properties with water and water logged condition of this plant. The germination of L. perfoliatum and L.sativum is linked to mucilage presence with more germination percentage than that without mucilaged seeds in abundance water conditions supporting the role of mucilage in adaptation.
2.1.4 Pharmacological Review of *Lepidium sativum*

**Vohora and Khan (1977)** Vohora and Khan proved the presence of cardioactive substance in seeds extract of *Lepidium sativum*, the made the research via cardiovascular phenomenon to study the pharmacological action of this plant proving the action via adrenergic mechanisms. There was sharp increase in Blood Pressure (40-80 mmHg, 5-15 min) when animals were treated with Ethanolic extract of *Lepidium sativum* seeds at a dose of 10-20 mg/kg, i.v. These effects are due to increase in rate and force of auricular contraction explaining that ethanolic extract works by not potentiating or depressing the pressure or action of adrenaline (2 pg/kg, i.v.) via carotid occlusion (45 seconds). This extract also (10-20 mg/kg, i.v.) caused the increase in ventricular movements of chest heart preparation. The same cardio stimulant results were also seen on isolated rabbit auricles muscles.

**Zisca et al (1982)** The work of Ziska and co-workers is well documented form of Antigen antibody reaction through chromatography on human immunoglobulin-Sepharose. The molecule of lectin from *Lepidium sativum* plant product directly reacts with human RBC irrespective of A, B, O and AB blood groups. The RBC from animal source is also agglutinated by this molecule of lectin. This agglutinating potential for erythrocyte is lost when the solution of lectin heated at 70°C or by dialysis using strong acids buffer, the same is not inhibited by monosaccharides carbohydrates.

**Atasan (1989)** Further *Lepidium sativum* was studied bone or fracture healing properties of its extract, which is common practice in Saudi folk medicine through protocol for collagen and tensile strength animal models. It was observed that there was increase collagen deposition in fracture area and the tensile strength was also enhanced in broken tibiae with the use of *Lepidium sativum* extract

**Patole (1998)** Patole et al carried the task to experiment the role of *Lepidium sativum* seeds extract in diabetic patients by evaluating the chances of starch hydrolysis to glucose. It was observed that there is sharp decrease by 41% by *Lepidium sativum* seeds on starch hydrolysis. Irrespective of 11 NIDDM and 14 normal humans, the affects of seeds was seen in reducing glucose activity or response with meal in both normal and NIDDM subjects. Moreover diabetic’s subjects showed higher fall in glucose level when compared to healthy one. But long term studies on such patients of diabetics at a dose of 15 gm/day of extracts showed fall of blood glucose to 8.3 mM/l from 10.2 mM/l in 9 out of 11 subjects.

**Ulrich et al (1998)** Ulrich et al studied the chemical structure of compounds in seeds of *Lepidium sativum* and found dimeric imidazole alkaloids five in number were lepidine B, C, D, E and F with established imidazole alkaloid lepidine. Semilepidinsoside A and B which were new imidazole alkaloids were of monomeric nature confirmed through spectroscopic spectral analysis

**Saba et al (1999)** New compound was isolated and reported by Saba and co-workers which was steryl ester present in the aerial parts of Lepidium sativum. Its spectralphotometric data shows this compound to be as stigmast-5-en3β, 27-diol 27-benzoate. Knowing very well its active potential with respect to therapeutic action, no further attempt was made to study it *L.Sativum* axial part was also reported to contain new steryl ester.

**Adam (1999)** There was a decline in growth rate along with hepato-n toxicty with 50% (w/w) *L. sativum* extract, however at 2% (w/w) seed extract of *Lepidium sativum* no toxic effects were observed on Wistar albino rats.
However at 10% (w/w) of L. sativum extract toxic effects were present but not lethal in nature which can be associated with depression in growth rate. Alteration in ALT and AST level along with urea, protein, cholesterol and other biochemical marker Anemia and Leukopenia was observed with Organ lesions

**Kassie et al (2003)** Kassie et al worked on by product or breakdown product of glucotropaninobtain from garden cress Lepidium sativum with glucotropaeoiiin and benzylisothiocyanate, shown the chemoprotective results due to genotoxicity and colonic preneoplastic lesions by 2-amino-3-methyl-imidazo [4,5-f] quinoline when represntive on single cell gel electrophoresis assays and aberrant crypt foci. There was a sharp fall in damage of hepatic cell of F344 rats 75-92% pretreated with either glucotropanin (150 mg/kg) or fresh garden cress juice (0.8 ml), either benzylisothiocyanate (70 mg/kg) for a length treatment ranging to 3 days on quinoline (90 mg/kg, 0.2 ml corn oil/animal)-induced DNA genetic damage in colon and hepatic cells. The garden juice analysis state that BITC is not at all showing its effect when worked with parallel experiment, it was due to decrease in the dose required to show the effects on cancer. The alteration in the activities of drug metabolizing enzymes like UDP glucuronosyltransferase, cytochrome P4501A2, and glutathione-Stransferase by garden cress extract was also worked on along with, glucotropanin and benzylisothiocyanate. benzylisothiocyanate and glucotropaeoiiin were unable to modulate the function of enzymes significantly, however garden cress juice showed marked changed function of hepatic UDPGT2. ACF protocol in which, quinoline feeding by gavage on alternate 10 days with oil corn at a dose of 100 mg/kg which receive 5% garden cress juice five days prior to start of quinoline treatment, subgroups was administered with which drinking water only. There was reduction in ACF as well as ACF with crypt multiplicity garden cress juice when challenged with quinoline alone.

**Maghrani et al (2005)** It was noticed by Maghrani and co-workers that fall in blood pressure with enhanced electrolyte and water excretion in case of aqueous seed extract of Lepidium sativum L. suggesting the role of Lepidium sativum seeds extracts on hypertension without marked change on cardiac output or rate. It can be clearly concluded that this is for the reason Moroccan population have importance and application of Lepidium sativum L. decoction in treatment of renal and cardiac disease

**Eddouks et al (2005)** Aqueous extract of Lepidium sativum does not altered the insulin level in plasma both in normal and diabetic rat after the treatment suggesting the anti diabetic potential is not related to pancreas. It can be concluded that the its aqueos extract is controlling the homeostasis of glucose in various organs like decrease or inhibition of glucose production in liver, in kidneys by alteration in glucose reabsorption or by glucose transporter proteins and in muscle by increasing the uptake and to conclude by suppressing the glucose absorption by intestine causing a marked hypoglycemic effects

**Gianazza et al (2007)** Gianazza et al were able to demonstrate the role of cadmium with altered concentration of Lepidium sativum L. when studied the increasing concentration of cadmium causes suppression in growth plantlets along with protein accumulation with a range 10–25 kDa. These proteins are also present in in extracts of L. sativum seeds. During seed germination metallic exposure can alter the protein catabolism and anabolism. The response to metal exposure during seed germination and initial plantlet elongation

**Stuven and Pfugmacher (2007)** The presence of microcystins may alter oxidative stress due to LR response as seen by change in lipid peroxidation.

36
The increase in α- and β-tocopherol and altered activity of enzymes such as glutathione reductase, glutathione peroxidase and S-transferase, glutathione is evident of decrease in oxidative stress. The Oxidative process observed by genetic damage and cellular damage via DNA or lipid peroxidation or protein inhibition due to cyanobacterial toxins is explanation to its anti oxidant property.

**Wright et al (2007)** Anti hypertensive effect for aqueous extract of *Lepidium sativum* with seeds was studied by Wright and co-workers both in normal or hypertensive rats. The duration of study was 3 weeks. The 3 week result indicate the decrease in systolic blood pressure to 178 mmHg in contrast to 189 mmHg a placebo one. Angiotensin-II blocker like a standard drug irbesartan, was even more potent in action, with fall in systolic blood pressure 154mmHg in 3 weeks with no changes in normal.

**Shukla et al (2011)** Neurobehavioral studies were under taken by Shukla and co-workers, their results suggest the activity is due to alkaloid contents of seeds from *Lepidium sativum*. Hypnosis by thiopental altered the motor coordination, analgesic activity, locomotor activity, antianxiety and on general pharmacology.
2.2 Aegle marmelos L

2.2.1 Plant Profile of Aegle marmelos

<table>
<thead>
<tr>
<th>Botanical Name</th>
<th>Aegle marmelos (L.) Corr.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Genus</td>
<td>Aegle</td>
</tr>
<tr>
<td>Species</td>
<td>marmelos</td>
</tr>
<tr>
<td>Family</td>
<td>Rutaceae</td>
</tr>
<tr>
<td>Vernacular names</td>
<td>Belo, Bel, Golden apple, Kuvilam, Bilvamu, Bael, Bela.</td>
</tr>
</tbody>
</table>

2.2.2 Description of Aegle marmelos

Armed tree of Aegle marmelos to to 2 (6) cm, spines axillary; branched pubescent; 8(15) m., with leaves either paired or single usually straight, from 3 to 5 cm long; leafletes elliptic, rectangular or oblong obviate; lateral 2.5 x 1 cm terminal; 4.8 x 2.5 cm; each, chartaceous, globarous, base unsubdivided or rounded, margin subcrenulate, 36 apex obtuse, acuminate, retuse; petiole 2.5 cm terminal with Panicles axillary, to 10x4.5cm, petiole to 5mm., Peduncle to 1cm and Pedicel to 2mm. Flowers 5 merous, bisexual, 2.5cm across. Calyx cupulour upto 5mm; lobes 4 - 5 triangular. Petals 5, white, oblong, and sub equal, 1 x 0.6cm, Fleshy, spreading. Disc obscure. Stamens α. ca. 5u; filaments upto 3mm, basally subconnate; anthers oblong, to 4mm. Ovary ovoid; >10 celled; ovules α per cell, Fruit oblong, stigma sub sessile.; Seeds α, oblong to 8 x 4 mm; Berry ovoid, 8 x 6 cm Woody New foliage- Feb month, Leaf- fall January Flowers- March. Fruits persistent, ripening by February month.

2.2.3 Pharmacognostical and Phytochemical Review of Aegle marmelos

Nadkarani (1927) Nadkarani and co-workers studied that in Aegle marmelos mucilage, pectin, sugar, tannin, volatile oil, bitter constituents, ash 2% and a balsamic acid resembling balsam of Peru are present. The extract of Aegle marmelos concentrated in vacuum and the thick syrupy mass diluted with water to precipitate fatty acid and resinous matters

Chakravarti and Dasgupta (1955) Chakravarti and Dasgupta reported that a sterol aegelin from the leaves of Aegle marmelos and It was first described as a steroid but a neutral alkaloid, with diethyl groups or one methyl with degradative studies and Aegelin as a structure has been established.

Chakravarty and Das (1958) Chakravarthi and Dasgupta reported that the ether extract of non-saponified part from aegle marmelos on chromatography yielded a sterol which identified as aegelin. It also reported that UV studies of aegelin shows the presence of trans-cinnamide and trans-cinnamic acid

Chatterjee et al (1967) Chatterjee and co-workers described the presence of the crystallized alkaloid as pale yellow solid which is confirmed by Characterization of the alkaloid using various spectroscopy techniques and expressed a significant peak at m-32.
Jain et al (1968) Jain and co-workers studied that *Aegle marmelos* are found from sub chain of Himalayan forests, Bengal, Burma and in the sub mountainous regions and cultivated almost throughout India.

Chatterjee and Majumdar (1972) Chatterjee and Majunder reported that *Aegle marmelos* has been found a phenolic base which having an pyridine and oxazole moiety from UV, IR, NMR and mass spectra.

Chakrabarty et al (1960) Chakrabarty and co-workers described phytochemical investigation of *Aegle marmelos* leaves including dry matter, crude proteins, fiber, hemicellulose, cellulose, lignin and ash value.it also reported that it contain tryptophan which inhibiting tyrosinase accelaring mechanism whereas Furanocoumarin exhibited tyrosinase accelaring in *Bufo melanostictus*.

Sharma et al (1980) Sharma and co-workers 1980 reported that *Aegle marmelos* seeds and its seed oil contains proteins and fatty acid components but *aegle marmelos* leaves yield marmesinin and rutin and ripe fruits yield xanthotoxal and both parts yield β-sitosterol.

Das and Das (1995) Das and Das studied that various biological active compounds were isolated from various parts of *Aegle marmelos*. Which indicate Presence of alkaloids in the roots and leaves of *Aegle marmelos* and coumarins with their constituents in the root and stem bark.

Krishnan et al (2000) Krishnan and co-workers reported the transverse section of *Aegle marmelos*. The epidermis is single layered with stomata on both surfaces and over-lined by a thick layer of cuticle. It also contain closely, packed oval cell without much intercellular space and chloroplasts in the palisade cells. Both upper and lower epidermal layers bear stomata which has two guard cells and two subsidiary cells.
Namibiаr et аl (2000) Namibiаr and co-workers described the taxonomic classification, description of plant including morphology, distribution, pharmacognostical studies leading to establishment for identification of the raw drugs used and cultivation methods of Aegle marmelos.

Ghosh et аl (2001) Ghosh and co-workers described the 13 type varieties of fruits which present in Aegle marmelos and explained that fruits are separated on the basis of size and shape of fruits and the fruits which were flat, oval, oblong spherical, and pear shaped were grouped separately.

Chowdhury and Yusuf (2007) Chowdhury and co-workers reported essential oil like alpha-Phellandrene (35.7%) subinene (16.7%), d-limonene (29%), subinene (16.7%) and alphapinene (6.9%), methyl chavicol (74.6%) and anethole (20%) from the leaves of A.marmelos which were analysed by Gas chromatography.

Mohammed et аl (2016) Mohammed et al were successfully able to isolate 7,8-dihydroxy-4-hydrofuroquinoline from Aegle marmelos (Linn.) Correa leaves and were alkaloidal in nature from furoquinoline group with cytotoxic activity called it as Aegelbine-A.

2.2.4 Pharmacological Review

Haravey (1968) Haravey, and co-workers reported that the alcoholic and aqueous leaf extracts of A. marmelos have marked effect on both force and contraction of amphibian heart almost same as in case of digoxin. On electrocardiograms It also reported that these extract stimulated the ventricle muscle of heart in dog.

Pannachan et аl (1993) Pannachan and co-workers reported the antidiabetic affect of alkaloid on Alloxan animal model in Aegle marmelos leaves.

Das and Das (1995) Das and co-workers 1996 studied the and reported generation of pancreas when damage in diabetic models of rat with prominent sugar lowering effects by water extract of the A. marmelos.

Singh et аl (2000) Singh et al reported that the chemo preventive potential against chemical carcinogenesis in the hydroalcoholic leaf extract of A.marmelos

Shoba and Thomas (2001) Shoba and co-workers reported that the anti-diarrhoeal effect was significantly low in using aqueous extract in castor-oil model when compared to methanolic of A.marmelos extract which showed greater anti-diarrhoeal. The Ricinoleic acid an active constituent of Castor-oil was able to reduce absorption of Potassium and Sodium ions with inhibition of partial Na+, K+ ATPase function in GIT of animal, further they also proved that methanol extract was much useful at higher doses $P_{0.001}$ compared to aqueous A. marmelos extract.

Sabu and Kuttan (2007) Sabu and Kuttan revealed that the methanolic leaf extracts of A.marmelos were given once daily for ten days orally to male wistar rats and sacrificed and glucose uptake value was studied by incubation of gastronemius muscle and diaphragm. Insulin treated sample showed increased C glucose uptake by 281 and 44% for muscle and diaphragm respectively. Treatment with A. marmelos leaf extracts increased the C glucose uptake in the gastronemius muscles significantly. It also reported that rats treated with A. marmelos leaf extract showed increase in concentration of the GLUT-4 protein in the homogenate of GC-muscles of rats compared to non-treated muscles. It also studied that methanolic leaf extract of Aegle marmelos in serum and liver decreased alloxan induced lipid peroxidation (LPO) significantly but increased superoxide dismutase (SOD) activity in liver significantly when compared with alloxan induced diabetic rats.
Gnanasam et al (2002) Gnanasam and co-workers reported the antifertility activity in the polyherbal formulation of dried aqueous extracts of Aegle marmelos leaves and the aqueous extract exhibited 90% antifertility activity at 1620mg/kg but 60% antifertility activity at 324mg/kg.

Gurulingappa et al (2002) Gurulingappa and co-workers studied the dose activity at 100mg/kg for anti-inflammatory potential in methanolic leaf extracts of A. marmelos and ethyl acetate. Their results were significant to prove the anti-inflammatory potential of these extracts.

Kar et al (2002) Kar et al was successful in demonstrating the alteration and regulation in concentration of thyroid hormone in male mice when different leaf extract in various doses was given to these animals Aloe vera and Aegle marmelos (125 mg/kg) with Bacopa monnieri (200 mg/kg).

Garg et al (2003) Garg and co-workers reported that the formulation of Aegle marmelos, Plantago ovata and Lipidium sativum, which are known as bowel care. It also reported that the aqueous ethanolic extract of A. marmelos unripe fruit showed potent anti diarrhoeal and antiulcer activity.

Kamalakkannan et al (2003) According to Kamalakkannan et al aqueous extract of A. marmelos was significantly able to decrease in blood glucose level in experimental animals for diabetes. Lipid peroxides and hydroperoxides levels were also elevated in such animals but the levels were altered by Aqueous extract of A.marmelos with changed in Vitamin C and reduced glutathione level in plasma.

Lampronti et al (2003) According to Lampronti et al there was a reduction in proliferation of K562 Jurkat and T-lymphoid Jurkat cells by A.marmelos extract. The same results were seen in MDA-MB-231 human cell lines, breast cancer MCF7 and erythroleukemic HEL.

Narender et al (2007) An alkaloidal amide, Aegeline 2 with antihyperglycemic and antidyslipidemic activity was isolated by team of Narender from leaves of A.marmelos. The compound of Aegeline 2, works on same principle as β3-AR agonist.

Arul et al (2005) Arul and co-workers alcoholic extract from leaves of A.marmelos leaves have marked action on the tracheal chain in dose dependent manner when challenged with histamine in ilium of guinea pig and tracheal chain. It is supposed that inhibition of H1 receptor, hence from this study it may be concluded that it can be used for Asthmatic condition, where histamine role is a decisive factor. There was significant reduction in inflammation in carrageenan induce rat paw model by using the various extract from A.marmelos leaves. The bipasic reaction in Odema formation is due to secretion of Serotonin and histamine later proteas, lysosome and prostaglandin plays vital role in its pathology, the analgesic activity was seen in all serial dilution in acetic acid-induced writhing model, hence can also used as antipyretic in mice.

Anandharajan et al (2006) Anandharajan and co-workers demonstrated the in vitro screening assays to validate the targets of in glucose transport, here upregulation of PI3 kinase with PPARγ and Glut-4, by A.marmelos is regulated for glucose transport.

George et al (2006) George and co-workers reported that the A.marmelos leaf aqueous extract was given to mice and it showed considerable increasing in the WBC count and bone marrow cellularity. The flow cytometric investigation indicates significant increasing in CD3, CD4, CD8 and NK cells. It was also observed that the remarkable increase in lymphocyte proliferation in AME treated mice in the MTS assay.
Shankarananth et al (2007) Shankarananth and co-workers reported that writhing activity of the extract of A. marmelos leaves significantly reduced which induced by acetic acid. The tail flick method used for extract of A. marmelos leaf at a dose of 200 mg/kg or and 300 mg/kg indicates prominent activity of analgesia. From these above results it concluded that the extract possesses central analgesic and peripheral activities in mice.

Sahare et al (2008) Sahare and co-workers reported that antifilarial effects against Brugial malayi microfilariae showed by the methanolic extracts of, A. marmelos. 100 mg/ml of root extract of A. marmelos Corr at given conc. Resulted in total loss of mobility microfilariae within 48 hr of experiment, there was significant amount of flavonoids, alkaloids and saponins roots of Vitex negundo L. and coumarin was present in A.marmelos leaves when observed on TLC

Preecha et al (2008) Preecha and co-workers reported this as important and genuine drug to alter the blood glucose and triglyceride level in plasma which may be due to new type of inhibitors from a-glucosidase family, phenylethyl cinnamides, aegelinosides A and B or anhydromarmeline is already isolated from, isolated from extract of A.marmelos

Chauhan and Agarwal (2008) Chauhan & Agarwal reported that at the dose of 200 and 300 mg/kg body for regular 60 days from 50% ethanolic Aegle marmelos leaf extracts have changed reproductive function, male rats at oral dose. The study was conducted for 120 days in which there was sharp change in serum testosterone level along with fall of spermatogenesis. In this caput and caudal and the height of epithelial cells along with normal tubule was drastically reduced. The histology of Leydig cells and sertoli cells shows decrease in pachytene and preleptotene spermatocytes in dose dependent manner. From above it may be stated that activity on antifertile character of A. marmelos is due to function and structural disturbance of somatic cells of testicles cells resulting in change of spermatogenesis. It also reported that the aqueous extract of A. marmelos leaves on the reproductive organs of male rats showed contraceptive effect significantly. Biochemical parameter of the reproductive tissues for protein, glycogen sialic acid, fructose, ascorbic acid and alkaline phosphatase showed a significant decrease where as testicular cholesterol level increased significantly which indicates changes in the biochemical parameter of genital organs. Fertility and other fertility effects were detected throughout drug treatment and after withdrawal, body weight gain was similar in all treated groups together with no changes in the weight of vital organs, serological parameters and hematological parameters.

Faizi et al (2009) Faizi and co-workers reported that A.marmelos leaves and its various extracts and pure compounds screened against Gram-positive and Gram-negative organisms for antibacterial activity. In antibacterial activity experiments, all the serial extracts and their compounds 1, 3, and 4 showed potent antibacterial activity against Gram-positive organism, while aegeline (3) also show inhibition the growth of a few Gram-negative organisms, whereas Amide 4 was also screened for any antineoplastic activity which was tested against three NCI cancer cell lines, 31 MCF7 (breast), SF-268 (CNS) and NCI-h460 (lung), and found to be inactive as an anticancer agent
Papi Reddy et al (2009) Reddy et al isolated lupeol as triterpenoid in the leaves of A. marmelos. Further they chemically synthesized the various derivatives to study the antihyperglycemic and antidyslipidemic potential of these newly synthesized derivatives like s (2-13) from the lupeol (1). The synthetic derivatives were able to lower the blood sugar levels to 25% from 18.0% at 24h from 5h, respectively, in streptozotocin induced model. There was also lowering of glycerol to 30 % and 40% of in triglycerides, with 24% reduction in cholesterol level with effective improvement in HDL.

Lai et al (2009) Lai et al studied the anti ulcer activity at different dose of (50, 150, 500 mg/kg) in animal studies the tannins from Pomegranate was able to lower the ulcer formation in water immersion stress and pylorus ligation model. Further the gastric mucosa was also deteriorated by pure ethanol, in dose-dependent manner. These tannins are known for their important role in treatment of gastric ulcer. There is increase secretion of t mucus and free mucus is readily available stomach wall from oxygen with decrease utilization of GSH – PX, SOD, and maintain content of NO at usual level.

Vijaya et al (2009) Vijaya and co-workers, 2009 studied that of 50 % of A. marmelos leaves ethanolic extract was able to lower the lipid level in animal model of rats using diet and triton. It was seen that that the elevated level serum cholesterol was inhibited by A. marmelos extract at a dose of 250 and 125 mg/kg in triton WR 1339 albino rats. At the said dose the extraxct was able to control elevated cholesterol and triglycerides values along with high-density lipoprotein cholesterol in high-fat diet- rat model. The results were compared to standard drugs of atorvastatin and gemfibrozil in experiment to give much better results.

Bhuwan et al (2010) Bhuwan. and co-workers reported that the A. marmelos seeds have antifungal due to presence of anthraquinone derivative in the form of 1-methyl-2-(3'-methyl-but-2'-enyloxy) against A. fmigatus and C. albicans fungus.

Baliga et al (2013) Baliga and co-workers reported importance and uses of bael fruits in treatment of stomach ache, diarrhea, dysentery, along with cardiac ailments. It also reported that bael fruits have many ethnomedicinal properties like wound-healing, astringent, hypoglycemic, antidiysenteric, anti-diarrheal, anti-inflammatory, demulcent, insecticidal, analgesic, antipyretic, with its marked antimicrobial potentials.

Bhatti et al (2013) Bhatti and co-workers reported antiproliferative activity of Aegle marmelos different extracts against various cell line of leukemia at a 12.5 μg/ml concentration with IC₅₀ but ethanol extract and its fraction furanocoumarin imperatorin showed potent antiproliferative activity.

Ramakrishna et al (2015) Ramakrishna and co-workers reported ant ulcer activity of Aegle marmelos fruits methanolic extracts in a dose dependent manner ranging from 25 to mg/kg, there was a reduction in gastric ulcer by 93.98, 93 %, 73 %, 52.4 %, 2.8 %, when it extract was administered orally. Further there was significant reduction in gastric secretion when methanolic extract was used in treatment of ulcerated rats, with reduction in catalase, glutathione reductase, superoxide dismutase, glutathione transferase and glutathione peroxidase, along with Vitamin E and C.
2.3 *Cichorium intybus* L

2.3.1 Plant Profile of *Cichorium intybus*

<table>
<thead>
<tr>
<th>Botanical Name</th>
<th><em>Cichorium intybus</em></th>
</tr>
</thead>
<tbody>
<tr>
<td>Genus</td>
<td><em>Cichorium</em></td>
</tr>
<tr>
<td>Species</td>
<td><em>Intybus</em> L</td>
</tr>
<tr>
<td>Family</td>
<td>Asteraceae</td>
</tr>
<tr>
<td>Vernacular names</td>
<td>Kasni, Chicory, Zichorie, Kasni, Hindaba, Kashni.</td>
</tr>
</tbody>
</table>

2.3.2 Description of *Cichorium intybus*

**Bais and Ravishnkar (2001)** Bais described the morphological character of *C. intyhus* that it contains angled stems and spreaded branche achieves 80-90 cm height. With the passage of time its tap roots attained brownish yellow hue. Outwardly it has a thin bark which makes it visualising. Centrally keeping xylem and a number of other vessels it is developed. Its flowers have a hue of bluishness. It is seen in clusters and to beautify it the axillary flowers are stouty, erected and greenish. Along with the inflorsence the flowers get a brownish black look and the seeds are 2.5 mm long. They are pointed and plano-convex cotyledons.

2.3.3 Pharmacognostical and Phytochemical Review of *Cichorium intybus*

**Scarpati and oriente (1958)** Scarpati and co-workers asserted that the chicoric acid was taken aside from chicory. The structure of chicoric acid was taken for granted through the synthesis of the optically active and racemic modifications from chloride cyclic carbonate, caffeic acid and D(-), L(+), and meso-tartaric acids, respectively.

![Chicoric acid](image)

**Nedelkovists and Mosonyi (1961)** Nedelkovists and co-workers stated qualitative and quantitative changes of chicory in the monosacchaildes and oligosaccharides contents that were formulated by paper chromatography during roasting. Glucose and fructose enhanced from 100-160°C, and then came down gradually.
**Dem'yanenko and Dranik (1971)*** Dem'yanenko and co-workers observed that Coumarins: cichorin, esculin, 6,7 dihydroxycoumarain, scopoletin, and umbelliferone were isolated from racemes of Chicory.

**Dem'yanenko and Dranik (1972)*** Dem'yanenko and co-workers hold that the hydroxycinnamic acids were put apart from the aerial parts of C. intybus plant. The identification of the chemical constituents came as caffeic, neochlorogenic acids chlorogenic, 3-feruloyl and 3-p-coumaroylquininic acids and dicafeyl tartaric acid.

**Dem'yanenko and Dranik (1973)*** Dem'yanenko and co-workers voiced that the Flavonoids, apigenin, quercitrin, luteolin 7-0- hyperin P-D-glucopyranoside, apigenin and 7-0-L-arabinoside were bifurcated from C. intybus shoots.

**Dem'yanenko et al (1974)*** Dem'yanenko and co-workers related the highest content of esculetin and its glycosides were found in the leaves and flowers of C. intybus. It was also added that preliminary hydrolysis of the glycosidic constituents multiplied the percentage of the issued substance.

**Wight and van (1983)*** Wight and co-workers were of the view that sucrose, reducing sugars, and inulin in chicory root were pre medicated by HPLC.

**Leclercq (1984)*** Leclercq and co-workers founded that Lactucin bitter constituent principle put apart from chicory a root which was determined by HPLC method.

---

![Lautucin](image1)

![Cyanidin](image2)
Bridle et al (1984) Bridle and co-workers discovered that the cyanidin 3-O-p-(6-O-malonyl)-D-glucopyranoside: a major anthocyanin was isolated from red leaves of chicory and specified by spectroscopic methods.

Cappelletti (1984) Cappelletti and co-workers observed that unmethylated aglycones Cyanidin with small amounts of delphinidin were seen in all cultivars varities of C. Intybus.

Mrugasiewicz et al (1984) Mrugasiewicz and co-workers said that the Cichorin was taken aside from extraction of chicory inflorescences with low molecular weight methanol. The raw cichorin held some traces of esculin. 60 % Cichorin was noted after recrystallisation with methanolic solvent.

Pyrek (1985) Pyrek and co-workers viewed that Sesquiterpene lactones like lactupicrin, lactucin, and 8-deoxylactucin were issued from C. intybus.

Sarah and Jeffrey (1985) Sarah and co-workers declared that the sesquiterpene lactones and their major phenolics components were taken in the chicory plant at different times during the harvest. The levels of the sesquiterpene lactones like lactupicrin, lactucin, and 8-deoxylactucin and the hydroxycoumarin cichorin were in abundance. These sesquiterpene lactones secreted in the latex which support a significant barrier to herbivory in chicory.

Kenji et al (1990) Kenji and co-workers showed that a sesquiterpenoid phytoalexin and Cichoralexin, were put forth from C. intybus seeds and its structure has been formulated by UV, 'H NMR, 'C NMR and mass spectroscopy.

Tens et al (1990) Tens and co-workers said that some new sesquiterpene lactones 13-dihydrolactucopicrin along with other seen sesquiterpene were taken apart from root of chicory and seen through by spectroscopic methods.

Anonymous et al (1992) Anonymous displayed that, there was notable decomposition of inulin during the roasting process and fruitifying product contains enhanced proportion of reducing sugars together with dextrin and caramel. Roasted chicory emitted a characteristic odour and contained acetic, lactic, pyromucic, pyruvic, tartaric acids and palmitic. Apart from it raw chicory contains only citric and tartaric acids. The volatile chemical constituents were marked as P-diketopentane, acetaldehyde, diacetylene acetone, maltol, furan, furfuraldehyde and methyl and furfuryl alcohols.

Evelin et al (1996) Evelin and co-workers incorporated that the major fatty acid present in the polar lipids of chicory leaves. But in flowering stalks like linoleic (33-62%) and palmitic (24-36%) its betters. So the changes in the fatty acid composition were noted after harvest in both leaves and flowering stalk. The changes were noted in the younger leaves in the first 4 days of postharvest. Floral stalks and leaves showed a deterioration in fatty acid content.

Park et al (2000) Park and co-workers ascribed that the artesin and magnoliadide were isolated from the roots of chicory and their structures were scaled by HMBC and NOESY NMR spectral interpretation as 1 beta-hyroxy eudesm 11-beta, 13-dihydro derivative and 4,13-dien-6,12-olide and, respectively.

46
Kisiel and Michalska (1999) Kisiel and co-workers reported isolation and structural illustration of lactucopicrin derivative from *Cichorium intybus* with the modification in structures of various sesquiterpene lactones which also isolated from *Cichorium* species. It was also taken as isolation and assumption of eudesmanolide magnolialide, guaianolide ixerisoside D it was as a transformation of sesquiterpene from chicory.

Bahar et al (2002) Bahar and co-workers denounced that a novel seco-sterol, cichosterol has been isolated and characterized as 13,14-seco-stigma 5(6), 14(15)-diene-3-p-oI and a rare sterol glycoside stigma 5(6)-ene-3-a-0-(p-D-glucopyranoside) from the seed of *C. Intybus*.

Cabezas et al (2002) Cabezas and co-workers brought out how inulin content in tubers decreased when the inulin, sucrose, fructose, and glucose contents in tubers of *C. intybus* kept at special temperatures (-18, 4 and 18 °C) after harvesting were investigated.

Rikke et al (2002) Rikke and co-workers added that four anthocyanins pigments were isolated from the blue perianth segments of *C.intybus* These pigments were marked as various derivative of delphinidin, coumaroyl quinic acid.

Kisiel and Michalska (1999) Kisiel and co-workers hold a new natural product, benzyl-b-glucopyranoside is apparent when various chemical constituents are isolated from *C.intybus*. They are known as Sesquiterpene lactones, cichorin etc.

D’Acunzo et al (2016) D’Acunzo and co-workers reported that chicory has a wide range of vegetables with eminent nutritional and medicinal value. It keeps sterol, total polyphenol, nitrate contents and antioxidant capacity in leaves. And the stem is also vital. it was also reported sitosterol and stigmasterol fractions (45-56 versus 38-43%) from the stem of chicory and it showed potent antidiabetes activity

Orford et al (2016) Orford and co-workers, revealed pasture species *Taraxacum* sp. and *Cirsium arvense* which to have the greater. Pollinator frequency and richness. but *Cichorium intybus* was an important species which does have a high pollinator and agronomic properties. It was also said that enhanced functional diversity, richness and abundance of the pollinator illustrated improved pollination.

2.3.4 Pharmacological Review of *Cichorium intybus*

Patel (1981) Patel and co-workers reported antimicrobial activity of alcoholic extracts of roots of *C. intybus* on micro-organism of inflamed gingival induced by *in vitro* sensitivity tests.. The chicory extract was found to be less potent than some common antibiotics of inflammation site. It also reported anti-inflammatory activity of chicory aqueous and alcoholic extracts with the treatment of intraperitoneal LD50 dose of chicory root in mice with dose levels of 8.9 g/kg and 9.3 g/k. it also reported that clinical trial of these extracts showed significant reduction of gingival inflammation index was observed when patients suffering from pyoixhoea massaged the inflamed/bleeding gums with alcoholic root extracts of chicory. Described that In vitro sensitivity tests with alcoholic extracts of roots of *C. Intybus* on micro-organism of gingival with inflammation revealed potent antimicrobial activity. The extract was found to be less potent than some common antibiotic.

Roy and Venkatakrishna (1983) Roy and co-workers reported definite impairment of spermatogenesis in the mice fed on 8.7 g chicory/kg and 4.3 g/kg aqueous chicory extracts treatment for ten days in the testes of mice which fed with above dose.
Bardhan et al (1985) Bardhan and co-workers described that the aqueous and butanol extracts of Liv-52 which containing various plant extracts stimulated the activity of aniline hydroxylase, aminopyrine, N-demethylase while the petroleum-ether extract of Liv-52 stimulated the activity of cytochrome oxidase, total ATPase and succinate dehydrogenase in the cellular mitochondrial fraction it also reported that the chloroform extract of Liv-52, inhibited the lysosomal acid phosphatase, acid ribonuclease and cathepsin B activity in total liver homogenate when it added to the post-mitochondrial fraction of liver of normal and CCU-treated rats.

Panday (1985) Panday and co-workers reported that the alcoholic extracts of kasani which is known as chicory caused developed bradycardia in normal and the heart of frog, and also slow down blood pressure with increase in respiratory rates in experimental dogs.

Seto et al (1988) Seto and co-workers reported isolation of four new sesquiterpene lactones, cichoriolide A and cichoriosides A, B and C from C. intybus plants which showed cellular toxicity activity in the L-5178 Y cultured cell system.

Kapur et al (1994) Kapur and co-workers reported that the Jigrine showed hepatoprotective action on hepatic damage which induced by paracetamol in experimental rats. Biochemical parameters like serum transaminases GOT and GPT, serum bilirubin, plasma prothrombin time and tissue lipid peroxides were also evaluated to assess the hepatic function. Oral treatment of Alcohol, CCl4 and paracetamol drugs produced an elevation in bilirubin, serum transaminases, plasma prothrombin time and tissue lipid peroxides in liver. It also reported these effect reduced by oral pretreatment doses of Jigrine. The hepato activity of Jigrine was compared with Liv-52.

Sultana et al (1995) Sultana and co-workers described that the plant extracts of Solanum nigrum and Cichorium intybus in the reaction mixture which containing calf thymus DNA and free radical DNA against oxidative cellular damage to its deoxy ribose sugar moiety based on the concentration of plant extracts. While the effect of Cichorium intybus was much effective as compared to extract of Solanum nigrum. These studies also revealed that the hepatoprotective activity of these plant extracts may be due to their ability towards suppression of the oxidative degradation of DNA in the tissue debris.

Saraswat et al (1995) Saraswat and co-workers described that the plant extracts of Solanum nigrum and Cichorium intybus in the reaction mixture which containing calf thymus DNA and free radical DNA against oxidative cellular damage to its deoxy ribose sugar moiety based on the concentration of plant extracts. Hepatoprotective activity of these plant extracts may be due to their potential to suppress the oxidative degradation of DNA in the tissue debris.

Sharma et al (1995) Sharma and co-workers reported the hepatoprotective of Hepatomed which an Ayurvedic drug containing aqueous extract of six medicinal importance plants viz., Adhatoda vasica Picrorhiza kurroci, Eclipta alba,. Cichorium intybus and Solarium nigrum showed significant slowdown in the level of malondialdehyde which induced by 1.5 mM cumene hydroperoxide. It als reported that Oral treatment of Hepatomed upto 3 ml/100g body weight for 15 days did not show any elevation in SGOT and SGPT. The results revealed that hepatomed an ayurvedic preparation is a strong hepatoprotective medicine with no observed adverse effects.
Gadgoli and Mishra (1997) Gadgoli and co-workers reported that *Cichorium intybus* plant extract fraction elevated the levels of SGPT, SGOT, ALP and T.bilurubin in hepatotoxicities which induced by CC\textsubscript{14} and Paracetamol upto 2 to 3 more fold. The *Cichorium intybus* plant methanolic fraction methanol soluble fraction coded FII showed potential protective action on the liver of rats were observed in SGOT, SGPT, ALKP and T.Bil levels against CC\textsubscript{14} and Paracetamol induced hepato toxicities.

Zafar and Ali (1998) Zafar and co-workers reported the total aqueous extracts of natural root callus extracts maintain the structural integrity and protection of hepatic cells. The protective effects are more effective when the experimental rats were treated with root callus extracts. This was confirmed by significant slowdown in serum ALT, AST, and in bilirubin content.

Mitra et al (1999) Mitra and co-workers studied that a polyherbal hepatoprotective formulation known as HD-30 which containing, *Cichorium intybus*, *Solanum nigrum*, *Picrorrhiza kurroa*, *Tephrosia purpurea* and *Andrographis paniculata* extracts was screened for its hepato protective activity against hepatotoxic causing agents,while treatment with polyherbal formulation HD-30 showed significant amelioration of toxin-induced changes in the hepatic biochemical parameter.

Sandhir and Gill (1999) Sandhir and co-workers reported prevention of ethanol induced hepatotoxicity because increase in activity of the enzyme y-glutamyl transpeptidase due to the treatment with Liv-52 and also showed has protective effects on the activity of glutathione and levels of superoxide dismutase. Hepatoprotective nature of an ayurvedic preparation Liv-52 might be attributed to its potential to inhibit lipid peroxidation.

Yim et al (1999) Yim and co-workers described that the methanolic extract of *C. intybus* gave a significant reduction of blood glucose levels in rats.it also reported its anti-inflammatory activity against carrageenin induced rat’s hind paw edema and potent inhibitory effects were observed at the dose of 1,000 mg/kg which were compared with aspirin as a control.

Amirghofran et al (2000) Amirghofran and co-workers reported importance of the *Cichorium intybus* in different solvent including the treatment of different diseases like allergies, inflammations, infections and hepato diseases. It also reported that the chicory extract can changes the immune reactions through their anti inflammatory activity. It also reported that the *C. intybus* ethanolic extract showed a complete inhibitory effect on the proliferation of blood lymphocytes in the presence of phytohemagglutinin at the concentration of 10 mg /ml. but does not have a direct mitogenic effect on lymphocytes or thymocytes of human body. This in vitro study revealed that ethanolic extract of chicory elevated the proliferation of lymphocytes after excitation with the allogenic cell.

Santhosh, et al (2000) Santhosh and co-workers reported the diuretic activity of chicory extract on oral administration with the dose levels of 1 ml of 10% extract/kg bw, for 28 days. The results revealed decreased the activity of oxalate synthesizing enzymes and increased urine output in the rats with chicory treatment.

Suhail et al (2000) Suhail and co-workers described that the importance of *C. intybus* powder for curement of various diseases and symptoms haemostatic, astringent, anti-inflammatory and analgesic in traditional unani system of medicine.

Saroja et al (2001) Saroja and co-workers described that enzymic antioxidants like catalase, peroxidase, superoxide dismutase and polyphenol oxidase and nonenzymatic antioxidants like ascorbate, tocopherol, total carotenoids, reduced glutathion and flavonoids and lipid peroxidation were evaluated in the leaves of the *C. intybus*.
extracts. It is also revealed that the leaves of *C. intybus* extracts possess potent and effective antioxidants activity by inhibiting lipid peroxidation.

**Kim and Yang (2001)** Kim and co-workers reported antioxidative effect of water extract of *C. intybus* on low density lipoprotein, and also the inhibitory effects on the production of TBARS and the degradation of fatty acids in low density lipoprotein.

**Hazara et al (2002)** Hazara and co-workers reported that an ethanolic extract of *C. intybus* root showed the tumor inhibitory effect of an ethanolic extract of *C. intybus* root against Ehiich ascites carcinoma in mice and revealed significant inhibitory effect results at doses from 300 to 700 mg/kg body weight.

**Rikke et al (2002)** Rikke and co-workers reported the isolation and identification of the blue perianth segments from *Cichorium intybus* and this pigments were identified as delphinidin 3-O-(6-O-malonyl-b-d-glucoside)-5-O-b-d-glucoside, 3-O-p-coumaroyl quinic acid and delphinidin 3,5-di-O-(6-O-malonyl-b-d-glucoside).

**Aqil et al (2003)** Aqil and co-workers reported potent antioxidant activity of *C. intybus* in benzene and acetone extract, which was determined by ferric thiocyanate and compared with thiobarbituric acid method.

**Bahar et al (2003)** Bahar and co-workers reported that *Cichorium intybus* extract in the petroleum ether, ethyl acetate, alcoholic extracts, and compound coded with AB-IV slow down the levels of AST, ALT, and ALKP, while the level of TP elevated against CCl4-intoxicated control group. The methanol fraction of *Cichorium intybus* extract and compound coded with AB-IV were found to be most potent at the dose levels of 500 and 250 mg/kg, respectively, exhibiting a slowdown in ALT, AST, and ALKP as compared to standard drug Silymarin against intoxicated control group in comparison to normal values.

**Prajapati et al (2003)** Prajapati and co-workers describe the location of chicory in all over the worlds. In Indian, it is wildly distributed in Punjab and Andhra Pradesh regions and also in Maharashtra, Himachal Pradesh, Gujarat, Tamil Nadu, Bihar, Orissa and Kerala. Majorly Chicory is cultivated in Belgium, Europe, Germany, France, Netherlands, Switzerland United Kingdom, and South Africa..

**Petrovic et al (2004)** Petrovic and co-workers reported the antibacterial activity of *Cichorium intybus* extract in the ethanol, aqueous, and ethyl acetate solvent. It also reported that extract of ethyl acetate possess potential antibacterial activity against various bacteria, while plant Aqueous extract inhibits Erwinia carotovora, Pseudomonas fluorescens, P. aeruginosa. Agrobacterium radiobacter.

**Theodore et al (2004)** Theodore and co-workers reported that the aqueous root extracts of *C intybus* contain sesquiterpene lactones Lactiicin mid Lactucopicrin and show antimalarial activity against HB-3 clone of strain hondurcis-I of *P. falciparum*.

**Wesolowska et al (2006)** Wesolowska and co-workers reported that the *Cichorium intybus*, extract contain guaianolide 8-deoxylactucin which show the anti-inflammatory activity by inhibiting the NF-β and central transcription factor. This transcription factor exited the expression of multiple inflammatory and genes encoding enzymes, immune genes, and genes encoding enzymes and inducible nitric oxide synthase. It als reported that an inhibition of PGE-2 production COX-2 protein and PGE-2 production expression by chicory extracts which a contain sesquiterpene lactones in human
colorectal cancer cells, due to its a prevention of the induction of COX-2 and protein expression which mediated by the inhibition of NF-β activation.

**Pushparaj et al (2007)** Pushparaj and co-workers reported the potential hypoglycemic effect in a dose 125mg/kg body weight in *Cichorium intybus* plant extract. It also experimented that daily administration of chicory extract (125 mg/kg) for 14 days diabetic induced rats attenuated triglycerides by 91%, serum glucose level by 20%, and total cholesterol by 16%. While, there was no change in serum insulin levels, which revealed the possibility that chicory extract induces insulin secretion from pancreatic β-cells and hepatic glucose-6-phosphatase activity was partially reduced by *Cichorium intybus* plant extract when compared to the control group of rats. It also reported that the reduction in the hepatic Glc-6-Pase activity could slow down hepatic glucose production, cause it lower the concentration of blood glucose in *Cichorium intybus* extract-treated diabetic rats.

**Hassan (2008)** Hassan and co-workers stated that Supplemented diet against nitrosamine-induced oxidative stress and hepatotoxicity in male rats was found in the *Cichorium intybus*. The finding of results shows that rats with nitrosamine precursors showed a increase in liver TBARS and total lipids, bilirubin total cholesterol, and enzymes activity (ALT, AST, ALP and c-GT) in both serum as well as liver. While a significant decrease in the levels of SOD, catalase, GSH, GSH-Rx, total protein and albumin was reported. The present findings also revealed that supplemented diet with chicory can be ameliorate the nitrosamine precursors which induced oxidative stress and hepatic disorders which may be responsible due to its effective antioxidant defense status and scavenging free radicals which are responsible for cellular damage.

**Li et al (2014)** Li and co-worker reported hepatoprotective activity of *Cichorium intybus* heporal doses of 6, 18, and 54 g/kg per day showed a significant hepatoprotective effect with dose of 54 g/kg per day which produced the largest significant effect by increasing GSH, SOD and reducing MDA levels in the liver.