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Chicory: A review on ethnobotanical effects of *Cichorium intybus* L.

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ABSTRACT

The history of taking medicinal plants goes back to the existence of man on the Earth. Almost all tribes and nations have used medicinal plants in their history. *Cichorium intybus* L. which is known to have various effects including anti-hepatotoxic, anti-malaria, blood glucose decreasing, anti-oxidant, and anti-inflammatory effects has been widely used in Iran and many other countries. It was traditionally taken as diuretic, laxative, and also a medicine that improves liver and gall bladder function as well as the appetite. Some of these effects have been approved with preclinical and clinical evaluations. In this study, we have tried to introduce the plant and its effects in traditional and modern medicine. This is achieved by reviewing the references published in recent years.

KEY WORDS: Chicory, *Cichorium intybus*, Hendibeh, Traditional medicine.

1. INTRODUCTION

Medicinal plants have been used since ancient times for prevention and treatment of various conditions such as diabetes (Bahmani, 2014; Asgary, 2014), atherosclerosis (Rafieian-Kopaei, 2014; Mirhosseini, 2014), cancer (Shirzad, 2011; Shirzad, 2009), infectious diseases(Karamati, 2014; Bahmani, 2014), amnesia (Rahnama, 2015; Rabiei, 2014), pain (Delfan, 2014; Delfan, 2014), and psychological disorders (Saki, 2014; Saki, 2014). A large number of drugs have also been prepared from herbal medicines (Rafieian-Kopaei, 2014; Baradaran, 2012; Asadi-Samani, 2014; Bahmani, 2014). With the establishment of new medicines, novel advancements and inventions induced some people to suppose that all achievements gained by traditional medicines are pointless and it was the beginning of disregarding the past of valuable resources. However, the issues related to medicinal plants have been among the most important and interesting issues of medical sciences in recent decades (Sewell and Rafieian-Kopaei, 2014; Bagheri, 2013). With the advent of new scientific achievements in the terms of extraction, purification, recognition and investigation of pharmacologic effects of herbal compounds, and performing several clinical studies on plants revealed that the earlier viewpoints were nonsense (Rafieian-Kopaei, 2014; Asgary, 2013; Gharipour, 2013; Khosravi-Boroujeni, 2012). The use of medicinal plants is growing due to the easy access and less harmful actions to the body in comparison to the synthetic drugs. Nowadays, more than 80% of the world population use medicinal plants or their preparations in their health care procedures.

Several studies have proved the potential effects of various medicinal plants (Bahmani, 2014; Gholami-Ahangaran, 2012; Khosravi-Boroujeni, 2013; Sadeghi, 2014; Asgary, 2013). Treatment by herbal medicines may have some advantages over treatment by single purified chemicals; as herbal medicines are the mixtures of more therapeutic or preventive components, and so might have more activity than single products alone. Pure compounds may also be prepared from medicinal plants (Tamadon, 2014; Rafieian-Kopaei, 2013; Delfan, 2014). Different by-products or secondary metabolites in medicinal plants have made them a valuable source for preparation of new medications (Bahmani, 2014; Bahmani, 2014). Other than specific ingredients with therapeutic activity, antioxidants activity of medicinal plants contributes to their beneficial effects (Nasri, 2013; rafieian-Kopaei, 2014).

Generation of free radicals may cause damage to DNA and other sections of the body leading to the development of various diseases such as infectious diseases (Bagheri, 2013; Rahimian, 2014), neurodegenerative disease (Rabiei, 2013; rabiei, 2014), gastrointestinal diseases (Hosseini, 2002; taghikhani, 2014), cancer (Darani, 2009; Clarke, 1997) and renal diseases (Rafieian-Kopaei, 2014; Baradaran, 2013). These free radicals can be neutralized by the antioxidants from various herbal medicines. Plant antioxidants are able to scavenge free radicals modulating oxidative stress induced diseases (Madihi, 2013; Baradaran, 2014; Howard, 1987). So the need to reuse and review the traditional medicine resources is felt as one of important source of herbal materials for preventing or treating the diseases.

In this review paper, attempts have been made to investigate one of the valuable herbal medicines (*Cichorium intybus* L.) and present the effects of it by reviewing the recently published documents along with demonstrating the great value of legacy inherited from ancient.

1.1. Chicory history: The chicory has a rich history dating back to the ancient Egyptian times. The history of identifying and taking Chicory refers to times before Greeks found it. Also the name of this plant is seen in Papyrus Ebers. Ancient Egyptians believed that consumption of this herb would help purification of the blood and liver and treatment of heart diseases. Ancient Romans used chicory roots as a boiled or raw vegetable to get relief from liver problems (Howard, 1987).

This legendary herb also finds a place in some of the earliest works of literature. Chicory was famous for its use as a substitute for coffee in the Napoleonic Era. There are some records that Confederate soldiers used chicory for similar purpose during the American Civil War. The era of the Second World War the Camp Coffee which was a rich coffee and chicory essence became popular in the United Kingdom (Howard, 1987).

The discovery that chicory root could be used as a substitute for the bean drink was a breakthrough in the United States. The Food and Agricultural Organization (FAQ) has listed the chicory as a plant native to western Asia Europe, and North Africa regions (Asadbeigi, 2014).

1.2. Plant description: *Cichorium intybus* L. (Chicory) is a member of Asteraceae (Compositae) family, known in Iran as Kasni, desert Chicory and Hendeba. It is an erect glandular biennial herb with a tuberous taproot and rosette of 30-70 leaves. The stem grows 30- 120 cm height; the lower leaves are larger, pinnately lobed and covered with hairs. The upper leaves (1-12× 7-30) on the elongated stem are very much smaller and their bases clasping the stem (Figure 1) (Asadbeigi, 2014).

Figure 1: *Cichorium intybus* L. (Chicory).

During the first year, the plant shows only the vegetative growth and produces flowers and completes its life cycle in the second year since it is an absolute long day plant. Chicory is cultivated for the dried roots of this plant and also its aerial shoot, which are used as a medicinal herb. Aerial shoots, leaf, flower, root and fruit are supplied in Markets. This plant is cultivated widely throughout Europa as pharmaceutical and ornamental plant. In Iran, it has been growing in the mountainous area, Khorasan, Gilan, Mazandaran, Zanjan, Tehran, Isfahan and many other regions (Ghasemi-Pirbalouti, 2009).

1.3. The nature and characteristics of Chicory: Chicory is a well-known plant found in most areas with large prolonged stiff leaves tasted nearly bitter with a livid large flower. The other type, namely, Hendibeh Albaghl is almost bitter that is known with its small leaves and livid flowers. Literature has referred to three kinds of Hendibeh and it seems that Hendibeh Baria (tasny) implies a certain species of Taraxacum while Chicory and Hendibeh Shami relates to Cichorium species (Ghasemi-Pirbalouti, 2009).

When the plant starts to bloom, the stems appear more or less hairy, sturdy and grooved. The Chicory stems are approximately 40-100 centimeters in height. The plant leaves are stalked, narrow and tapering without lobes. The Chicory flowers appear bright blue, with a hint of purple color, but may also be seen in white or pink colors. The plant blooms between July and October. Each bloom can last only for one single day. The flowers usually open up and expand in the morning, however, they close up as noon approaches. These Chicory fruits do not have calyx or feathery hairs on the body These fruits are distinguished by the toothed scales on the apex (Ravishankar, 2001).

1.4. The isolated compounds from Chicory: A wide variety of compounds have been isolated from chicory. The most important of them are as follows (Carazzone, 2013; Norbak, 2002; Papetti, 2013; Iranian Herbal Pharmacopoea, 2002; Nasri, 2004): Apigenin-7-O-glucoside, Artesin, Campesterol, Caffeic acid, 3-Caffeoylquinic acid, 5-Caffeoylquinic acid, Chlorogenic acid, Cichoriolide , Cichorioside, Cichorioside B, Cichoralexin, Crepidiaside A, Crepidiaside B, Cyanidin 3-O-p-(6-O-malonyl)-D-glucopyranoside, 4-Caffeoylquinic acid, 5-Caffeoylshikimic acid, cis-5-Caffeoylquinic acid, cis-Caftaric acid, trans-Caftaric acid, 3-O-p-Coumaroyl quinic acid, Cyanidin 3-O- β -(6-O-malonyl)-D-glucopyranoside, 5-p-Coumaroylquinic acid, Cyanidin-3-O-(6″-O-malonyl)-glucoside, Cyanidin, Cyanidin-3-O-galactoside, Cyanidin-3-O-glucoside, Chrysoeriol-3-O-glucoside, Cyanidin-3-O-(6″-O-acetyl)-glucoside, Cyanidin-3,5-di-O-(6″-O-malonyl)-glucoside, Delphinidin-3-O-(6″-O-malonyl)-glucoside-5-O-glucoside, 1-3-Dicaffeoylquinic acid, 1-4-

Dicaffeoylquinic acid, 3-4-Dicaffeoylquinic acid, Dimethoxycinnamoyl shikimic acid, Dicaffeoyltartaric acid (chicoric acid), 3-5-Dicaffeoylquinic acid, 4-5-Dicaffeoylquinic acid, 8-Deoxylactucin, Delphinidin 3,5-di-O-(6-O-malonyl- β -D-glucoside), Delphinidin 3-O-(6-O-malonyl- β -D-glucoside)-5-O- β -D-glucoside, Delphinidin 3-O- β -D-glucoside-5-O-(6-O-malonyl- β -D-glucoside), Delphinidin 3,5-di-O- β -D-glucoside, Jacquilenin, 11-β-13-Dihydrolactucin, 11-13-Dihydrolactucopicrin, 3 and 4 β-Dihydro-15-dehydrolactucopicrin, (7S, 8R)-3′-Demethyl-dehydrodiconiferyl alcohol-3′-O- β –glucopyranoside, 4-O-Feruloylquinic acid, 5-O-Feruloylquinic acid, Isorhamnetin-7-O-(6″-O-acetyl)-glucoside, Isorhamnetin-7-O-glucoside, Isorhamnetin-7-O-glucuronide, Kaempferol-3-O-glucosyl-7-O-(6″-O-malonyl)-glucoside, Kaempferol-3-O-sophoroside, Isorhamnetin-7-O-neohesperidoside, Ixerisoside D, Lactucin, Lactucopicrin, Loliolide, Kaempferol-7-O-glucosyl-3-O-(6″-malonyl)-glucoside, Kaempferide glucuronide, Kaempferol-7-O-glucoside, Kaempferol-7-O-rutinoside, Kaempferol-7-O-glucuronide, Kaempferol-7-O-(6″-O-malonyl)-glucoside, Kaempferide-3-O-(6″-O-malonyl)-glucoside, Kaempferol-3-O-glucuronide, Kaempferol-3-O-glucuronide-7-O-glucoside, Kaempferol-3-O-(6″-O-malonyl)-glucoside, Kaempferol-3-O-glucoside, Kaempferol-7-O-neohesperidoside, Kaempferol-7-O-(6″-O-acetyl)-glucoside, Kaempferol-3-O-(6″-O-acetyl)-glucoside, Magnolialide, Malic acid, Malvidin-3-O-glucoside, Myricetin-7-O-(6″-O-malonyl)-glucoside, Oxalic acid, Pelargonidin-3-O-monoglucuronide, Petunidin-3-O-(6″-O-malonyl)-glucoside, Putrescine, Quercetin-3-O-glucuronide-7-O-(6″-O-malonyl)-glucoside, Quercetin 3-O- β -D-glucoside, Quinic acid, Quercetin-7-O-galactoside, Quercetin-3-O-(6″-O-malonyl)-glucoside, Quercetin-7-O-glucoside, Quercetin-7-O-p-coumaroylglucoside, Quercetin-7-O-glucuronide, Quercetin-7-O-(6″-O-acetyl)-glucoside, Shikimic acid, Succinic acid, β –Sitosterol, Sonchuside A, Sonchuside C, Spermidine, Stigmasterol, Tricin-3-O-glucoside.

Chicory has a bitter taste. The two sesquiterpenes, lactucin and lactopicrin have been considered as the main bitter substances of Chicory. Other ingredients include aesculin, aesculetin, cichoriin, scopoletin, 6-7-dihydrocoumarin, umbelliferone and some glycosides (Ravishankar, 2001).

1.5. Traditional uses of Chicory: Razi, a famous Iranian ancient physician mentioned in his book that chicory relieves the pain and inflammation of the stomach, opens liver channels and cleans the urinary tracts. The other resources of Iranian traditional medicine explain the following properties for this plant (Ghasemipirbalouti, 2009; Iranian Herbal Pharmacopoea, 2002; Nasri, 2004).

When leaf extract is used locally with or without vinegar along with *L. mubla mulatna S*, it can be useful for migraine, severe headache, and biliary disorders. If the plant is used along with *L. mubla mulatna S*, vinegar and water flower it can be useful for Hives and chronic itching. Besides it can be helpful for severe swelling of body and eye pain when is used with a special type of wine. Also it is beneficial when swelling of body is occurred. Poultice of leaf along with barley flour can be effective for strengthening the heart. The chicory juice is effective for obstruction of the liver, spleen, jaundice, edema and strengthening the liver, as well as gastritis. The more effectivey improves liver disorders. Additionally, it can clean urinary tract and help removing bladder stones. With drinking purified chicory juice accompanied with Sekanjabin can be helpful in some complications. The poultice of leaf and its juice revealed to be an antidote of deadly spice and its root can be used as a remedy for moth's and bee's bites. Its poultice accompanied by barely flour can lessen the swelling induced by gout. Chicory seed can improve biliary disease, liver disorders and jaundice and is useful for flushing out toxins and stimulating the appetite. Its root can be effective in removal of phlegm in the throat and also in cleaning urinary tract. Furthermore, it is reported to be helpful in elimination of intestinal edema and joint pain and blood purification. Nowadays, chicory is predominantly used as diuretic, analgesic, diaphoretic, antipyretic, particularly its juice which is extracted from distillation of the aerial parts of the plant.

Chicory is well known for its toxic effects to the internal parasites. All parts of Chicory especially the root contains volatile oils effective at elimination of intestinal worms. The majority of the toxic components are also present in the root. Orally consumption of chicory by farm animals causes reduction of worm burdens (Haring, 2007).

The flowers of Chicory are used in Germany as a folk medicine for the treatment for everyday ailments. It is also used as a tonic and as a treatment for cuts, bruises, as well as sinus, gastro-intestinal gall stone problems. Chicory contains inulin which may help general health, improving bowel function, weight loss and constipation. In rats, it may increase calcium absorption and bone mineral density (Athanasiadou, 2007).

1.6. Pharmacological studies about Chicory:

1.6.1. Anti oxidant and Anti inflammatory activity: One of the most important and obvious characteristics of chicory is its antioxidant activity. It seems that this effect is mainly due to the presence of various polyphenolic compounds (Heimler, 2009). The presence of compounds like sesquiterpene lactone, especially 8-daxi lactose as a strong cyclooxygenase inhibitor and some flavonoids can cause a clear anti-inflammatory activity in this medicinal herb (Cavin, 2005).

1.6.2. Hepatoprotective activity: Chicory has shown anti-hepatotoxic properties in animal studies. 34-37 A study showed high protective effects against carbon tetrachloride-induced hepatotoxicity on animals (Ahmed, 2003).

1.6.3. Neuroprotective activity: Chicory can cause neuro-protectivity and also can prohibit the harms of neurons induced by oxygen free radicals (Marteau, 2011). Chicory is a potent antioxidant and antioxidant compounds have shown good neuro-protection (Rabiei, 2014; Rabiei, 2014). Hence this effects of Chicory has been attributed to antioxidant activity of the plant.

1.6.4. Anti diabetic activity: The plant extraction causes to reduce glucose in streptozotocin-induced diabetic rats. Moreover, the plant's tannin led to inhibit the activity of fats generation in liver and deposition in fat cells. It looks that taking chicory can lead to an increased glucose removal in blood (Pushparaj, 2007).

1.6.5. Anti microbial activity: In recent years, chicory's anti-microbial activity have been revealed on some microbial strains such as *Agrobacter, Radiobacterium pseudomonas, Florecens* and *Pseudomoas aeroginoas* (Stanojkovik, 2004). Some sesquiterpene lactone compounds including lacticin and lactucopicrin have shown anti-malaria activity on samples (Bischoff, 2004).

1.6.6. Anti allergic activity: Chicory was has been shown to have anti-allergic activity by inhibiting cells responsible for first response sensitivity (Hyung, 1999).

1.6.7. Anti testicular toxicity: This plant has shown an appropriate protective effect in a study of tetrachlro carbon tetrachloride-induced testicular toxicity (Gazzain, 2000).

1.6.8. Diuretic activity: Chicory extract, especially the root extract can modulate glomeruli filtration. In general, insulin can be seen in most Compositae families that seem to be the responsible of this effect (Chopra, 1956). Many activities have been reported for inulin including stimulation of the immune system, reducing the number of pathogenic microorganisms in the gastrointestinal tract, reducing the risk of osteoporosis by increasing the absorption of minerals especially calcium, reducing the risk of atherosclerosis by reducing the synthesis of triglycerides and fatty acids in the liver and adjusting the hormone levels like insulin and glucagon (Kaur Gupta, 2002). A study investigated the effect of alcoholic extraction of chicory's root on induction of colon cancer. The results implied the efficiency of herb on preventing this kind of cancer (Pool-Zobel, 2002).

1.6.9. Increase in bilirubin excretion: UDP-glucuronosyl transferase enzyme plays in important role in glucuronidation of bilirubin process especially when is binding to glucuronic acid that finally results in bilirubin excretion. It seems that some compounds found in chicory extraction such as quercetin, luteolin and apigenin act as strong enzyme inducer (Chopra, 1956).

1.6.10. Protective effect against acute pancreatitis: Lately, a study findings has reported that hydroalcoholic extract of chicory's root and aerial shoot show a significant effect in preventing the symptoms of acute pancreatitis in animal model by serolin (Tousch, 2008).

2. DISCUSSION AND CONCLUSION

Human being has turned to nature and has taken plants to treat diseases since the beginning of life. Several-thousand-years history of herbal medicines demonstrates valuable experiences and information in the field of plant therapy (Bahmani, 2014; Bahmani, 2014). Paying attention to the nature and therapeutic properties of medicinal plants led to the collection information which is used by physicians to treat patients or by researchers to evaluate them and prepare new drugs (Shirani, 2011; Sarrafzadegan, 2013).

Specific activity and properties have been attributed to each plant in the traditional medicine resources and chicory is not excluded. Similar to the other plants, the properties of chicory is reported mostly based on observations and experiences. So it is less often noticed by experimental studies which seek to discover the mechanisms. Nowadays, oxygen free radicals have shown to have essential effects on developing many diseases such as atherosclerosis (Sarrafzadegan, 2013; Rahimi-Madiseh, 2014), infections (Rafieian-Kopaie, 2013; Bagheri, 2014) renal toxicities (Baradaran, 2013; Behradmanesh, 2013; Rafieian-Kopaei, 2013; Rafieian-Kopaei, 2014) and hepatotoxicity (Heidarian, 2013; Heidarian, 2012). Antioxidants have been shown to counteract with free radicals to prevent (Asadi, 2013; parsaei, 2013) or treat (Sharafati, 20111; Nasri, 2013) these diseases. Chicory as an enriched source of phenolic compounds is a plant with high antioxidant properties. Therefore, other than specific compounds effective on some diseases, it may act with its free radical scavenging properties.

Chicory also has sesquiterpene lactone compounds particularly in its roots which are strong inhibitor of prostaglandin synthesis through prohibiting cyclooxygenase 2 enzyme. Accordingly, chicory with certain anti-inflammatory properties is effective in treating many inflammatory diseases. By discovering sesquiterpene lactone as a composite with certain anti-inflammatory properties, an increasing emphasis has been placed on them by researchers to find new patterns for their extraction and concentration that act as COX-2 enzyme inhibitors (Ripol, 2008; Wang and Cui, 2009). Studies have suggested that chicory is enriched of chicoric acid which can cause metabolic changes particularly reduced blood sugar and increased insulin level.

As mentioned before, this plant is being used frequently to treat biliary disorders. The presence of some flavonoids such as quercetin, luteolin and apigeni that all of them act as the UDP-glucuronosyltransferase simulator can cause an accelerated bilirubin excretion process. Considering this effect, chicory sounds to have an effect on jaundice treatment.

As mentioned before, most of pharmacological and therapeutic properties of Chicory have been attributed to its antioxidant activity. If it is true, there are a lot of plants with free radical scavenging activities (Bahmani, 2014; Amirmohammadi, 2014; Bahmani, 2015; Bahmani, 2013; Eftekhari, 2012; Bahmani, 2011; Bahmani, 2015; Bahmani, 2013; Bahmani, 2015; Bahmani, 2015; Forouzan, 2012; Bahmani, 2012; Bahmani, 2015; Bahmani, 2012; Delfan, 2015; Bahmani, 2015; Delfan, 2015). Hence these plants may also have some of these effects which worth examining.

It should be noted that many properties and effects recorded previously as traditional medicine should be evaluated in a scientific way. By investigating the literature more precisely and using recent scientific findings, new pharmaceutical products can be prepared either formally or traditionally. Undoubtedly, this plant will be a great achievement in future based on the facts that either many helpful complexes is exploited from it or several pharmacological studies will be done on these compounds.

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