ISSN: 0975-8585

Research Journal of Pharmaceutical, Biological and Chemical Sciences

REVIEW ARTICLE

Ferula foetida"Hing": A Review

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ABSTRACT

Herbal drugs consist of a number active phytoconstituents which has furnished mankind with a number of herbal remedies for wide range of diseases for centuries. The herbal drugs still constitutes a major share of healthcare remedies in developing countries. The officially recognized systems of health in India such as Ayurveda, Unani and Homeopathic are still been used by about 70% of India's population. *Ferula foetida*commonly known as "Hing" have shown promising therapeutic value due to the prescence of various therapeutic phytoconstituents such as Terpenoids, Sulfide derivatives, Volatile Oil, Phenols, Minerals. The various pharmacological actions such as the antioxidant, antimicrobial, antifungal, anticancer, antidiabetic and various other activity have been studied. This review highlights the available information on *Ferula foetida* by giving due consideration to the ethno botany, pharmacognostic characteristics, traditional uses, phytoconstituents and summary of various pharmacological activities. Various other aspects has also been discussed in the review. This study can be useful in creating an interest towards hing and can be useful in developing new formulations with better and improved therapeutic value.

Keywords: *Ferula foetida,*Hing, phytoconstituents, terpenoids, sulfide derivatives

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ISSN: 0975-8585

INTRODUCTION

Herbal remedies prepared from various herbal drugs have been used against various disease since from ancient times. Over past few years compounds from natural origin have been gaining importance due to the prescence of the vast phytoconstituents present in it and the vast chemical diversity it offers. This has resulted in an increased demand in herbal preparations. The increased demand is because of the relatively safe use of the herbal drugs and its ease of availability [1,3].

*Ferula foetida*is a PERENNIAL which grows to about 2m by 1.5m and requires dry or moist soil. Mostly the dried latex (oleo gum resin) obtained by making deep incision in the roots or rhizomes are preferred for the medicinal as well as for culinary purpose [2].

Scientific Classification [17]

Kingdom : Plantae
Division : Magnoliophyta
Class : Magnoliopsida
Family : Umbelliferae
Genus : Ferula
Species : Foetida

Botanical description

Fig 1 Images of asafoetida

Fig 2 Images of oleo gum resin of asafoetida

It is a perennial plant which attains a height of upto 12 feet in wild with a circular mass of 30-40 cm leaves. The stem leaves have wide sheathing petioles. Flowering stems are 2.5-3 m high and 10 m thick and hollow. These flowering stems have number of schizogenous ducts in the cortex containing resinous gums. The flowers are small and dirty yellow colored produced in large compound umbels. Fruits of this plant is oval, thin, flat, reddish brown in color and contains milky substance. Roots are thick, massive and pulpy. The foul odor comes from the resin like gum extracted from the stems and roots [15, 16] Fig 1,Fig 2.

ISSN: 0975-8585

Parts Used

Oleo gum resin extracted from the roots and rhizome [12].

Origin and Distribution

The species *Ferula foetida*has got its origin from Afghanistan and Iran. It has been distributed throughout the Mediterranean region to Central Asia. In India it has been grown widely in Kashmir and in some parts of Punjab [12].

Ayurvedic Properties (5)(17)

Rasa : Katu
Guna : Tikshna
Vipak : Katu
Virya : Ushna
Dosha : Balances Vata, Kapha and increases Pitta

Method of Collection of Drug

The cortex of the stem and the root comprises of a large number of schizogenous ducts filled with whitish gum resinous emulsion. After a duration of five years when the roots has stored sufficient reserves and is about 12 to 13 cm thick at the crown, it throws up a large flowering stem about 10 cm thick and 2.5 to 3 m high. About the end of March just before the plant is about to flower, the upper part of the root is laid bare and the stem is cut off close to the crown, the exudation flows from the cut surface and while it is hardening is protected by dome like covering of stick and leaves. A few weeks later the hardened gum resin is scrapped off, a slice of the root is cut off and the juice is again allowed to exudates. This process will be repeated several times with interval about 10 days [6, 12, 16].

Synonyms [9, 17]

Sanskrit : Ramatha, Sahasravedhi
Assam : Hin
Bengali : Hing
English : Asafoetida
Gujarati : Hing, Vagharni
Hindi : Hing, Hingda
Kannada : Hingu, Ingu
Kashmiri : Eng
Malyalam : Kayam
Marathi : Hing, Hira
Oriya : Hengu, Hingu
Punjabi : Hing

Tamil : Perungayam
Telugu : Inguva
Urdu : Hitleet, Hing

Macroscopic Features of Asafoetida [2, 15, 16]

Colour : Yellowish-white changing to reddish-brown
Odour : Intense, persistent, penetrating and alliaceous
Taste : Bitter, alliaceous and acrid
Size : The tears are 0.5 to 3 cm in diameter
Shape : It occurs in 2 different forms i.e. tears and masses. Tears are rounded or flattened

Phytochemistry

Phytoconstituents are the chemical components of the herbs with some protective or disease preventive property associated with it. They are beneficial to the human in a number of ways. There are vast array of chemical components in herbal drugs.

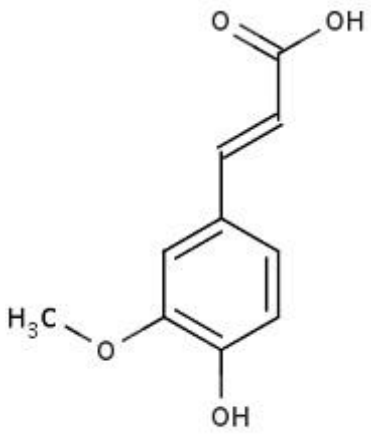
Asafoetida comprises of resin (40 to 65%), gum (20 to 25%) and volatile oil (4 to 20%). The resin portion of asafetida consists assaresinotannol as it's key constituents in the free or combined form as esters of ferulic acid. The various sesquiterpenecoumarins present in asafoetida are assafoetidnol A and assafoetidnol B .There are various newly isolated sesquiterpenecoumarins which are epi-conferidone, colladonin, karatavicinol, 8-acetoxy-5-hydroxyumbelliprenin and asacoumarinFreeferulic acid is present in the oleo gum resin. Free umbelliferone is absent in the drug which is a distinguishing feature as compared to galbanum. Ferulic acid on treatment with hydrochloric acid is converted into umbellic acid which further looses water to form umbelliferone. Galbanic acid is also one of the widely present sesquiterpene in resin portion of the drug. The gum fraction consists mostly of glucose, galactose, 1- arabinose, rhamnose and glucuronic acid [2, 8].

The oil of asafoetida is usually obtained by steam distillation of oleo-gum resin. The oil comprises mostly of volatile polysulphides. About seven volatile sulphide components are reported in the oil obtained by steam distillation which are the dimethyl trisulphide, 2- butyl methyl disulphide, 2- butyl methyl trisulphide, di-2-butyl disulphide, di-2-butyl trisulphide, di-2-butyl tetrasulphide and an unnamed component. Apart from the above mentioned volatile polysulphides there are numerous terpenoidal compounds present additionally which are α-pinene, phellandrene, bornyl acetate, α-terpineol, myristic acid, limonene, longifolene, cadinene, fenchone, eugenol, linalool, geraniol, β-caryophyllene, β-selinene, farnesol, cadinol, guaiacol, myrcene [13, 41].

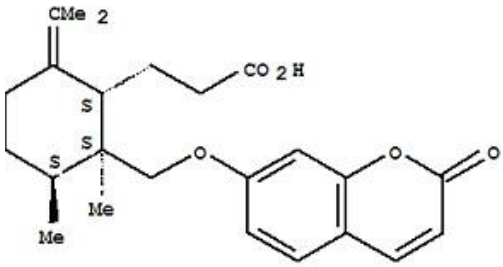
The various studies conducted on *ferula foetida* resin led to the isolation of numerous sesquiterpenecoumarins which are foetidine, saradaferin, 10-R-acetoxy-11-hydroxyumbelliprenin, 10-R-karatavicinol, methyl galbanate, lehmferin, feselol, ligupersin A,

ISSN: 0975-8585

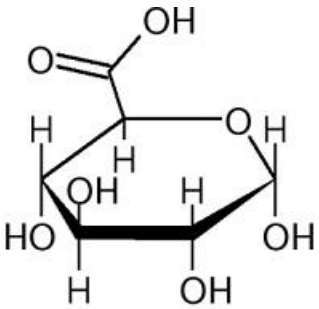
microlobin and polyanthinin. Apart from the aforesaid sesquiterpenes and the volatile polysulphides the various other phytoconstituents are the diterpenes like the 7-oxocallitrisic acid, picealactone C, 15-hydroxy-6-en-dehydroabietic acid, various phenolic compounds like vanillin, 3,4-dimethoxycinnamyl-3-(3,4-diacetoxyphenyl) acrylate, acetylenes such as falccarinolone and various other miscellaneous compounds such as oleic acid and β-sitosterol [2,13,41].



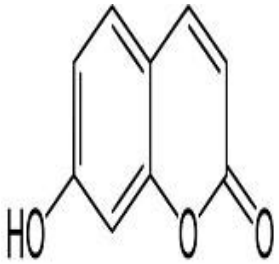
Ferulic Acid



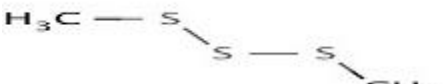
Galbanic Acid



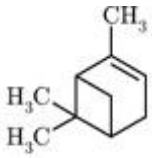
Glucuronic Acid



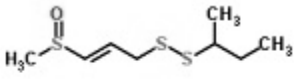
umbelliferone



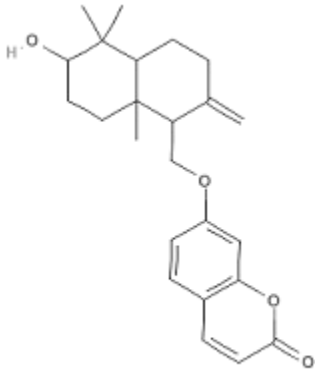
Dimethyl Trisulphide



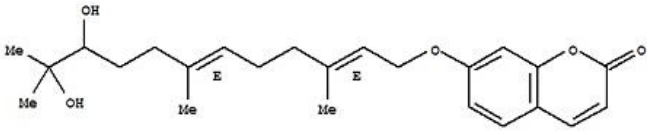
α-Pinene



Foetisulphide

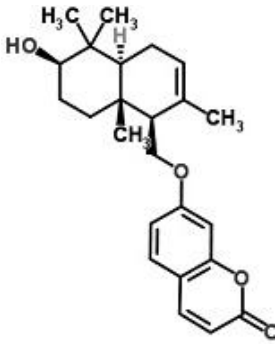


colladonin

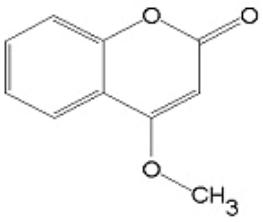


karatavicinol

ISSN: 0975-8585



feselol



4 methoxycoumarin

Luteolin and luteolin-7-O-β-D-glucopyranoside are the chief constituents widely present in the fruits of *ferula foetida*. Colladonin 4-methoxycoumarin is the chief constituents present in the leaves. Sesquiterpenecoumarins such as foetidin, 4 methoxycoumarin, colladonin, asafoetidnolA, assafoetidnol B and various other compounds such as the gummosin, polyanthin, badrakemin, neveskone, samarcandinandgalbanic acid are the constituents present in trhe roots. Apart from the above mentioned sesquiterpene compounds the roots of asafoetida also consist of a volatile polysulphides derivatives chiefly present only in the roots which are the foetisulphide A and foetisulphide C[41, 32].

Medicinal Applications

The oleo gumresin obtained by making deep incision in the roots and rhizomes of the *ferula foetida*has been widely employed because of the immense medicinal properties it posses. As such asafetida has been referred as the "Food of the Gods." Asafoetida as a herbal plant furnishes with a number of diverse uses such as it has been widely employed as an aid for digestion, as an expectorant, as remedy for headaches. Previously it was employed as an aid for digestion as it works on gas and bloating associated with it. But apart from being used as an aid for digestion it also furnishes with a number of applications such as its significant anthelmentic activity against roundworms and pinworms. The syrup prepared by decoction of asafetida has been widely used because of its prominent expectorant activity it posses and has been used for treatment of whooping cough it also has been used for asthma and various other respiratory disorders as there are evidences that essential oil is eliminated from the lungs. In classical Unnani form of medicine asafetida have been used as measures for combating epilepsy. It works as a great antidote against snake bite and as an insect repellant when mixed with garlic. Mixing asafoetida with sufficient quantities of water has shown great promises against migraine and headaches [3, 10].

Recently it has been found out that the roots of asafoetidaposses antiviral properties as well. Asafoetida prevents the growth and division of various infected cells thus giving an evidence about its utility in cancer prevention. Asafoetida functions as a sedative relaxes the nerve and finds it use in a number of nervous disorders which is one of its important health benefits. The powder acts as an antidote to opium by relieving depression, hysteria and mood swings. The colloidal solution of the oleo gum resin of asafoetida can be used as an anti-

ulcerogenic agent. It imparts a relaxant effect as well on the muscles and hence functions as an anti-spasmodic agent. The aqueous extract of the oleo gum resin shows promising anti-diabetic activity [3,4,18].

Pharmacology

The resin obtained by making deep incisions in the roots and rhizomes of the species *Ferula foetida*furnishes with a number of activities such as the anticholesterolemic, anticoagulant, antifertility, antifungal, antihepatotoxic, anti-inflammatory, antioxidant, antiparasitic, smooth muscle relaxant activity, anti-diabetic, antiulcerogenic and digestive enzyme inhibition are some of them but the most significant them is the anticarcinogenic activity, anthelmintic activity and its antispasmodic activity

1. Antispasmodic Activity

Antispasmodics are those class of drugs which have been used in relieving and treating stomach cramps. The drugs relieves the spasm by counteracting the effects of neurohormone acetylcholine by doing so the movements of stomach and the intestine would be decreased as well as the secretion of stomach acids and digestive enzymes will also be reduced.

Hassanabad et al. reported the antispasmodic activity of the oleo gum resin by conducting the study of the aqueous extract of asafoetida on the isolated guinea pig ileum. The contractile responses on the isolated guinea pig ileum where induced by administering acetylcholine, histamine and KCl and then the mean contractile response was noted. After induction of the contractile response on the ileum the aqueous extract was then administered, it was observed that after administration of 3 mg/ml of extract the average amplitude of spontaneous contractions on the isolated guinea pig ileum was decreased upto an extent of about 54 ± 7%. Gholamnezhad et al. reported that the relaxant effect of asafoetida was due to the potent inhibitory effect of the asafetida extract on the muscarinic receptor and also due to the partial inhibitory property of the herb on the histamine (H1) receptor [19, 20, 35].

2. Antifungal Activity

Houghton et al. reported the antifungal activity of asafoetida against *Microsporeumgypseum*and*Trichophytoninterdigitale* [22]. The 95% ethanolic extract of the dried gum was found active on agar plate. Sitara et al., reported the antifungal effect of asafoetida oil against *Microsporeumgypseum*and*Trichophytoninterdigitale.* It was observed that essential oil obtained from the rhizome was against the aforesaid species at a concentration of about 400 ppm on an agar plate, it also showed mild activity against *Trichophytonequinum* [22,37]. Gowda et al. reported 24% inhibition on *Aspergillusparasiticus* growth by the oleo gum resin on potato dextrose agar [42].

3. Antioxidant Activity

The antioxidant plays a vital role in prevention of number of diseases. Nabavi et a. reported the antioxidant activity of aqueous-ethanol extracts of the leaf, steam and flower by evaluating the DPPH, H_2O_2, the nitric oxide scavenging activity, haemoglobin induced linoleic acid peroxidation and Fe2+ chelating ability. The leaf aqueous-ethanolic extract showed better DPPH radical scavenging activity and also exhibited better H_2O_2 scavenging and Fe2+ chelating activity as compared to the other extracts whereas the stem extracts showed a better nitric acid scavenging activity as compared to the other two. It was observed that all the extracts exhibited good antioxidant activity in linoleic acid peroxidation test [23]. Cheng et al. and Pradeep et al. reported that ferulic acid and umbellifedrone responsible for antioxidant activity [24, 25].

4. Anti-Diabetic Activity

Diabetes is a chronic disorder affecting a major population worldwide. A sustained reduction in diabetes would result in reduction of number of microvascular disorders. Abu-zaiton et al. reported the antidiabetic activity of aqueous extract of asafoetida against pancreatic β cells damaged from alloxan-induced diabetes in rats. Asafoetida led to a significant reduction in blood glucose level and an increase in serum insulin level. It was observed that the level of glucose in animals subjected with alloxan was 10.28±0.85mmol/l whereas the level of glucose in diabetic group treated with asafetida extract was found out to be 6.75±0.31. There was also a significant rise in insulin secretion in diabetic animals which were subjected withy asafetida extract which was 0.48±0.05 as compared to diabetic animals which was found out to be 0.33±0.06 [26, 33].

5. Anti-Microbial Activity

Mishra et al. reported the antimicrobial activity of asafoetida by determining the Minimum Inhibitory Concentration (MIC) of aqueous and alcoholic extracts of asafoetida against various bacterial and fungal strains such as *B.subtilis, S.aureus, E.coli, P.aeruginosa, C.albicans*and *P.chrysogenum* by agar well diffusion method. It was observed that the agar well diffusion method yielded the inhibitory zone of about 16 to 34 mm diameter and the MIC value ranged from 12.5 mg/ml to 3.125 mg/ml [27, 36].

6. Antiulcer Activity

Rafatullah et al. evaluated the antiulcerogenic property of aqueous suspension of asafoetida on different ulcer induced models of Wistar albino rats. Gastric ulceration was induced by ligation of pylorus of the rats, by administration of suspension of indomethacin in 1% carboxymethylcellulose in water and induction of gastric lesions by necrotizing agents such as by 80% ethanol, 0.2 M NaOH and by 25% NaCl. After administration of suspension there was a significant protection in all models. The aforesaid observations were supported by histopathological assessment of gastric tissue and by determination of gastric wall mucus

(GWM) contents of the stomach as these parameters showed better protection of various indices and by replenishing the depleted (GWM) level by suspension treatement [28, 39].

7. Hepatoprotective Activity

Dandagi et al. studied the hepatoprotective activity of various extracts such as those of *Ferula foetida, Momordicacharantialinn and Nardostachysjatamansi*against experimental hepatotoxicity. The extracts of petroleum ether(60-80), chloroform, benzene, ethanol and aqueous of *Ferula foetida, Momordicacharantialinn and Nardostachysjatamansi*were evaluated for their respective hepatoprotective activity against carbon tetrachloride-induced liver toxicity in Wistar rats. Polyherbal suspension of the above mentioned extracts were prepared and the respective hepatoprotective activity was evaluated by determining the levels of serum enzymes such as glutamate oxaloacetate transaminase, glutamate pyruvate transaminase and alkaline phosphatsase. It was observed that administration of polyherbal suspension reduced the levels of serum enzymes. The biochemical observations were further supplemented by the histopathological examinations of liver sections. The experimental data suggested that polyherbal suspension of the extracts showed promising activity against the carbon-tetrachloride induced hepatotoxicity [29].

8. Antihaemolytic Activity

Nabavi et al. studied the antihaemolytic activity of the aqueous-ethanolic extracts of flower, stem and leaf of *Ferula foetida regel* against H_2O_2 induced haemolysis in rat erythrocytes and it was observed that extracts yielded better results [23].

9. Chemopreventive Activity

Neeraj Mishra et al. studied the chemopreventive activity of the aqueous and alcoholic extracts of asafoetida, ginger, cinnamon and cardamom on human breast adenocarcinoma cell line (MCF) and HEP-G2 cancer cell lines through in-vitro growth inhibitory assay. A significant activity as cytotoxic agents for tumor cells was observed for both the aqueous as well as alcoholic extracts of asafoetida, ginger, cinnamon and cardamom. A decrease in MCF and HEP-G2 cell population by crude extract was observed. Among the above mentioned extracts the crude extract of asafoetida showed the maximum inhibitory effect as compared to the other. Unnikrishnan et al. studied the tumor reducing activity of asafetida by oral administration of the extracts in mice transplanted intraperitoneally with Ehrlich ascites tumor [30].

10. Antiviral Activity

Chang and Wu et al. reported the antiviral activity against Influenza A (H_1N_1) virus. For reporting the activity the methanolic extract of asafoetida was prepared and then the crude extract partitioned between n-hexane-methanol (1:1) and the methanolic extract thus obtained was partitioned between chloroform-water (1:1) which yielded a chloroform extract. The

extract thus obtained was found to posses significant antiviral activity against Influenza A (H_1N_1) [31].

11. Antihypertensive Activity

Hassanabad et al. reported the hypotensive activity of asafoetida on Sprauge-Dawleyratsanasthetised with thiopental. The aqueous extract of asafoetida when administered at concentration of about 0.3-2.2mg/100g body weight reduced the mean arterial blood pressure in anasthetised rats [19, 35].

Important Formulation

Hingwashtakchurna, Agnimukhchurna, Hinguvachadichurna, Hingutrigunaleham, Ashtachurnam, Hingwadigulika, Ayaskriti, Phalasarpis, Pulileham, Kumaryasavam [17].

Toxic Effects

Asafoetida has been found to be relatively non-toxic as such. A report of methaemoglobinaemia has been associated with the administration of asafoetida in milk. It was observed that asafoetida exerts an oxidizing effect on fetal haemoglobin but not on adult haemoglobin. A week chromatid exchange- inducing effect in mouse spermatogenia and clastogenicity in mouse spermatocytes has been documented for asafoetida. The aforesaid chromosomal damage induced by asafoetida is due to the prescence of the coumarin constituents in it. An unusal swelling of the lips has been noticed after the use of asafoetida. Extensive facial and oral swelling can be considered as signs of allergic reaction of asafetida. Treatement with asafoetida can result in stomach upset in certain patients. Patients on high dose of asafoetida experience an unusual headache and dizziness. Skin rashes have been observed in few patients as signs of allergic reaction towards asafoetida [18, 43].

CONCLUSION

*Ferula foetida*commonly known as “Hing” has been widely used as a spice as well as a flavouring agent for culinary purpose. The oleo gum resin essentially contains sesquiterpenecoumarins, volatile disulphides, free ferulic acid and some ferulic acid esters. It also been used since centuries for treating gastric upset and various abdominal disorders. There are various herbal formulations that have been mentioned in Ayurvedic literatures in which asafoetidaare the key ingredient. A number of pharmacological studies conducted on the species *Ferula foetida*revealed that it poses a number of activities such as antioxidant, antiulcer, hepatoprotective, antimicrobial, antifungal but some of the recent studies has revealed that it posses antiviral activity which is active against influenza A (H_1N_1) virus. Various literature and some studies has reported about the cancer preventive activity of asafoetida. The aforesaid pharmacologicalactivities confirms the therapeutic value the herb posses which need to be harnessed.

ISSN: 0975-8585

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