

Pharmacological activities and therapeutic uses of resins obtained from *Ferula asafoetida* Linn.: A Review

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Abstract

Ferula asafoetida Linn. is a chief source of *Asafoetida*, a sturdy, obstinate and sulfurous odor, and oleo-gum-resin of medicinal and nutritional significance. *Asafoetida* is used in food as a flavoring agent and also has been used as traditional medicine for many diseases in the world. Recent studies have shown numerous promising activities mostly muscle relaxant, memory enhancing, digestive enzyme, antioxidant, antispasmodic, hypotensive, hepatoprotective, antiviral, antifungal, anticancer, anxiolytics, and anthelmintic activities. It is used in the prevention and treatment of several problems such as unwanted abortion, unusual pain, sterility, and mainly ailment for women such as difficult and excessive menstruation and leukorrhea. Moreover, it is used for stomach pressure, flatulence, low acid levels in the stomach, and loose stools. This review deals with study of various phytoconstituents, pharmacological, and therapeutic effects of *Asafoetida*.

Key words: Antidiabetic activity, antifungal activity, *Ferula asafoetida* Linn, ferulic acid

INTRODUCTION

Asafoetida (*Ferula asafoetida* L.) is the plant utilized for manufacture of dried latex (gum oleoresin) which is exuded from the rhizome and stems of this plant belonging to the family Umbelliferae. A milky secretion exudes from the cut surface of rhizome, stems and the dried exudates are scraped off. The plant grows 1-1.5 m tall and possesses extremely dissected leaves the inconspicuous yellow flowers have been kept in compound umbels. The bark is black and wrinkled which contains great amounts of gelatinous alliaceous juice.^[1,2] The other species of *Ferula*, such as *Ferula rigidula*, *Ferula rubricaulis*, *F. asafoetida*, *Ferula alliances*, and *Ferula narthex* are other sources of *Asafoetida*.^[3-5] *F. asafoetida* also grows wild in the southern and central mountains of Iran. The oleo-gum-resin *Asafoetida* is called “Anguzakoma” “Anghouzeh,” and “Khorakoma” in Iran. Other names in some different languages are shown in Table 1. *Asafoetida* is an herbaceous perennial plant with an unpleasant odor that grows to about 2 m in height belonging to family Apiaceae.

The oleo-gum-resin is generally produced by incisions on the roots or by removal of the stems from the plant. Dried exudates (oleo-gum-resin) are collected and packed for export. *Asafoetida* occurs in two principal forms, mass and tears and mass form is the most common in the market.^[3,6] *Asafoetida* consists of mainly three portions including gum (25%), resin (40-64%), and essential oil (10-17%). The resin portion contains coumarins, sesquiterpene coumarins, and ferulic acid; its esters and other terpenoids. The gum includes rhamnose, glucose, l-arabinose, galactose, glucuronic acid, polysaccharides, and glycoproteins. The volatile fraction contains monoterpenes, sulfur-containing compounds, and other volatile terpenoids. The fractionation studies of *Asafoetida* have led to the identification of some exciting bioactive compounds like antiviral sesquiterpene coumarins obtained from *Asafoetida* which is more potent than amantadine against influenza-A.^[7] *Asafoetida* is a bitter

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taste and possess characteristic sulfurous odor. In addition, people in Nepal eat it, in daily diets and also thought that *Asafoetida* has diuretic, sedative, and aphrodisiac properties.^[8,9] It is also used in the treatment of various diseases such as intestinal parasites, flatulence, influenza, epilepsy, stomachache, asthma, and weak digestion.^[3,5,7] The pharmacological studies include antioxidant,^[10] cancer preventive,^[11,12] antidiabetic,^[13] antiviral,^[7] hypotensive,^[14] antifungal,^[15-17] antispasmodic,^[14] and molluscicidal^[17,18] from this oleo-gum-resin. It is used to treat worm infections as well as snake and insect bites.^[19,20]

SCIENTIFIC CLASSIFICATION^[21]

Kingdom: Plantae
Division: Magnoliophyta
Class: Magnoliopsida
Family: Umbelliferae
Genus: *Ferula*
Species: *Asafoetida*.

CHEMICAL CONSTITUENTS PRESENT IN ASAFOETIDA

In general, *Asafoetida* consists around 68% of carbohydrates, 16% of moisture, 4% protein, 1% of fat, 7% of minerals, and 4% of fiber.^[22] There are three main portions in *Asafoetida* which includes gum (25%), resin (40-64%), and essential oil (10-17%).^[5] The resin portion contains coumarins, sesquiterpene coumarins, and ferulic acid and its esters and other terpenoids. The gum portion includes 1-arabinose, rhamnose, glucose, galactose, glucuronic acid, polysaccharides, and glycoproteins. The volatile fraction contains monoterpenes, sulfur-containing compounds, and other volatile terpenoids.^[23] Sulfur compounds in *F. asafoetida* resin show various biological activities and can be valuable in medicine.^[24] Three main sulfur constituents which have been identified include 2-butyl 1-propenyl disulfide, 1-(methylthio) propyl 1-propenyl disulfide, and 2-butyl 3-(methylthio)-2-propenyl disulfide.^[5] The main chemical constituents of *F. asafoetida* are well characterized and given in Table 2.

PHARMACOLOGICAL ACTIVITIES OF ASAFOETIDA

In addition, it has been observed that *Asafoetida* possess a wide range of pharmacological activities which are scheduled in Figure 1.

Antidiabetic Activity

Diabetic is emerging epidemic around the world which considers as chronic untreatable condition due to insulin

Table 1: Name of *Asafoetida* in various languages of the world

Name	Language
Kama, Anguza	Afghan
Shajarat-ul-Heltit, Angudan	Arabic
A-wei	Chinese
Duivelsdrek	Dutch
<i>Asafetida</i> , Stinking assa, Devil's dung	English
Pirunpaska	Finnish
Ase-fétide	French
Stinkender assand, Teufelsdreck	German
Hing, Hingu	Hindi
Ordogyoker	Hungarian
<i>Asafetida</i>	Italian
Hing, Hingu	Nepali
Kama, Anguza	Pakistan
Zapalniczka Cuchnace, <i>Asafetida</i>	Polish
<i>Asafetida</i>	Russian
<i>Asa-fétida</i>	Spanish
Dyvelsträck	Swedish
Seytan tersi, Seytan boku, Seytan otu	Turkish

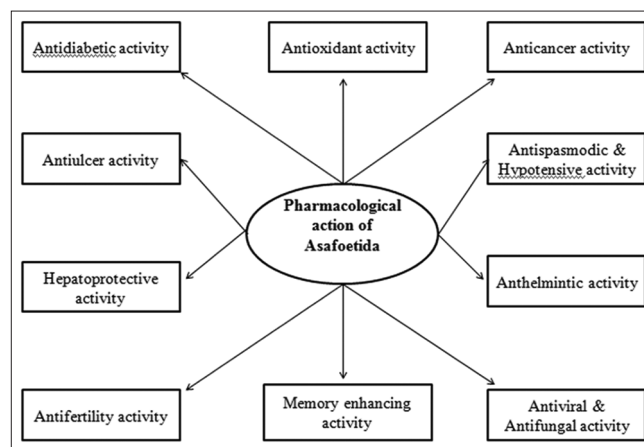


Figure 1: Pharmacological activities of *Asafoetida*

deficiency that effect 10% of population.^[25] The mechanism of *Asafoetida* action involves the regularization of blood glucose. It has proved that the effect of *Asafetida* on the secretion function of the pancreas is a result of their direct correlation with the cell membrane. Through carrier, Glut-2 the glucose enters to beta cell of the pancreatic islet Langerhans, where during metabolism adenosine triphosphate (ATP) created.^[26] Then, the production of ATP stimulate the insulin secretion by changing the membrane potential, which finally ensure the Ca^{++} ion flow into cytoplasm.^[27] *Asafoetida* has a high concentration of calmodulin which transport calcium in beta cell. The sensitivity of the beta cell to Ca^{++} is increased by the action of other secondary messenger. Calcium stimulates the tyrosine kinase leading to activation of insulin and its

Table 2: List of main chemical constituents present in *Asafoetida*

Main chemical constituents	Main chemical constituents	Main chemical constituents
Umbelliprenin	Methyl galbanate	2-Butyl 1-propenyl disulfide
5-Hydroxyumbelliprenin	Lehmferin	Methyl 1-(methylthio) propyl disulfide
8-Hydroxyumbelliprenin	Feselol	Di-2-butyl disulfide
Tadshiferin	Ligupersin A	Methyl 1-(methylthio) ethyl disulfide
Galbanic acid	Epi-conferdione	1-(Methylthio) propyl propyl disulfide
8-Acetoxy-5-S-hydroxyumbelliprenin	Microlobin	1-(Methylthio) propyl 1-propenyl disulfide
Conferol	Umbelliferone (7-hydroxycoumarin)	Asadisulfide
Gummosin	Sulfur-containing compounds	2-Butyl methyl trisulfide
Episamarcandin	2-Butyl 1-propenyl disulfide	Di-2-butyl trisulfide
Episamarcandin acetate	1-(Methylthio) propenyl disulfide	Di-2-butyl tetrasulfide
Fransiferol A	2-Butyl 3-(methylthio)-2-propenyl disulfide	Foetisulfide A
Fransiferol B	2-Methyl-2-propanethiol	Foetisulfide C
Fransiferol C	2,3-Dimethylthiirane	Diterpenes
Asacoumarin A	1-Methylthio-(Z)-1-propene	7-Oxocallitric acid
Assafoetidin	1-Methylthio-(E)-1-propene	Picealactone C
Ferocalicin	Dimethyl disulfide	15-Hydroxy-6-en-dehydroabietic acid
Assafoetidinol A	S-Methylpropanethioate	Phenolics
Assafoetidinol B	2-(Methylthio) butane	Vanillin
Polyanthinin	3,4-Dimethylthiophene	3,4-Dimethoxycinnamyl-3-(3,4-diacetoxyphenyl) acrylate
Kamolanol	Methyl (Z)-1-propenyl disulfide	Sesquiterpenes
Foetidine	Methyl (E) 1-propenyl disulfide	Taraxacin
Saradaferin	Dimethyl trisulfide	Fetidone A
10-R-Acetoxy-11-hydroxyumbelliprenin	2,3,4-Trimethylthiophene	Fetidone B
10-R-Karatavicinol	2-Butyl vinyl disulfide	Ferulic acid

secretion from the cell. This activity was observed by the boiling water extract of oleo-gum-resin (IP) dosage 0.2 g/kg for 14 days using Alloxan-induced diabetic rats.^[13]

Antioxidant Activity

The free radicals play a key role in various disease conditions. The biochemical reactions generate reactive oxygen species in our body which are capable of damaging essential bio-molecules. If, reactive oxygen species are not effectively scavenged by cellular constituents, they cause disease conditions.^[28] Such actions of free radicals can be blocked by antioxidant substances by scavenging them and detoxify the organism. It has been recently published that the plant has essential oil components.^[29] In this study, antioxidant activity of the essential oil components from the *F. asafoetida* was examined by *in vitro* 1,1-Diphenyl-2-picryl-hydrazyl (DPPH) and nitric oxide radical scavenging assay, reducing power, linoleic acid and iron ion chelation power, and establishing usefulness of this plant. The extract from aerial parts of *F. asafoetida* showed good but different

levels of antioxidant activity in all the models studied. These extracts had good Fe⁺⁺ chelation ability; DPPH and nitric oxide radicals scavenging activities. Further investigation of individual compound, determines various ways of antioxidant mechanisms involved.^[30]

Anticancer Activity

It has been studied that the aqueous and alcoholic extracts of *Asafoetida*, ginger, cinnamon and cardamom on HEP-G2 cancer cell lines and human breast cell line (MCF-7) showed the chemopreventive activity throughout *in vitro* growth inhibitory assay. The aqueous as well as alcoholic extracts of *Asafoetida*, ginger, cinnamon, and cardamom was observed as cytotoxic agents against these tumor cells. A decrease in HEP-G2 and MCF-7 cell population was observed with these crude extracts. Many studies stated about tumor reducing activity of *Asafoetida* using oral administration of the extracts in mice by intraperitoneal transplantation in Ehrlich ascites tumor.^[31] The cytotoxicity may be due to the high contents of essential oils in *F. asafoetida* which are toxic for biological systems^[29,32,33]

and also due to essential oils of different *Ferula* species. The sesquiterpenes, coumarins, phenylpropanoids, and disulfide compounds are the bioactive secondary metabolites obtained from *F. asafoetida*. The cytotoxic properties of stylosin (a monoterpenes extracted from *Festuca ovina*) and mogoltacin (a sesquiterpene coumarin from *Ferula badrakema*) against tumor cell line have shown by inducing DNA lesions and increasing apoptosis of cells.^[34] The sesquiterpene prenylated coumarin derivative ferulenol of *Asafoetida*, which cause toxicity to the plant and responsible for antibacterial properties as well as cytotoxicity toward human tumor cell lines. The most of the sesquiterpene coumarins were stored in the root part^[35] which may be deliberated as potential biological compounds for the treatment of malignancies.^[36] *F. asafoetida* has been reported to possess ferulic acid and farnesiferols which can prevent angiogenesis, vascular endothelial growth factor accelerated processes and the development of mouse Lewis lung cancer in mice.^[33] In this study, the methanol extract is more cytotoxic compared to the ethanol extract. The yields of an extract of *F. asafoetida* resin using ethanol (516.1 g) and methanol (558.6 g) extractions were 0.752% and 2.390% w/w, respectively. These results were in line with a previous study in which the data exhibited that the absolute methanol have a greater yield than ethanol.^[37] Some study also exhibited the aqueous and alcoholic extracts tested for *in vitro* cytotoxicity study.^[38] The result showed that aqueous extracts were considered to be less cytotoxic to these cells than their alcoholic extracts of the species. In addition, the aqueous extract has less inhibitory action than alcoholic extracts due to the variable amount of flavonoid and polyphenolic contents which are known to have antioxidant and chemopreventive actions.^[39,40]

Antispasmodic and Hypotensive Activity

Fatehi *et al.* demonstrated that *F. asafoetida* gum extract was helpful in reducing blood pressure in anaesthetized normotensive rats. This effect of gum extract on the contractile responses of the isolated guinea-pig ileum stimulated by histamine, acetylcholine, and KCl; therefore mean arterial blood pressure in the rat was investigated. There was decrease in average amplitude of contractions of the isolated guinea-pig ileum was observed when opposed to control. The exposure of precontracted ileum treated with acetylcholine to *F. asafoetida* gum extracts caused relaxation in a dose-dependent manner. The gum extracts appreciably reduced the mean arterial blood pressure in anaesthetized rats. It has also been noted that *F. asafoetida* gum extract possess some good relaxant compounds which interfere with a range of histamine, muscarinic receptor and adrenergic activities, or the movement of calcium ions across membrane required for smooth muscle contraction non-specifically.^[41]

Antiviral Activity

Recently, *in vitro* antiviral activity of *Asafoetida* was evaluated against some human rhinovirus (HRV) serotypes.^[14] In this

study, the *Asafoetida* gum resin inhibited the cytopathic effects in HeLa cells induced by HRV-2 in a dose-dependent manner. The mentioned study further streamlined for use of this gum resin in the upper respiratory diseases in traditional medicine.^[7]

Antifungal Activity

Essential oils obtained from 20 different spices were evaluated for their antifungal activity against *Aspergillus niger*, *Candida albicans*, *Candida cylindracea*, *Candida tropicalis*, *Candida blank*, *Candida krusei*, *Candida glabrata*, and *Saccharomyces cerevisiae* by disc diffusion method. The sensitivity of fungi toward different types of essential oils was compared with Ketoconazole as standard drug. Among the selected spices, *Asafoetida* oil showed inhibitory activity toward all fungal strains, but strong activity toward *C. tropicalis*, *C. albicans* MTCC-227, *S. cerevisiae*, and *A. niger* while moderate activity toward *C. blanki*, *C. glabrata*, *C. krusei*, *C. cylindracea*, *C. albicans* MTCC-3017, and *C. albicans* NCIM-3100 was observed. Sitara *et al.* evaluated antifungal activity of the essential oils extracted from the seeds of neem, mustard, and black cumin and *Asafoetida* in 0.5, 0.1, and 0.15% against eight seed borne fungi, viz., *Aspergillus flavus*, *A. niger*, *Fusarium moniliforme*, *Fusarium oxysporum*, *Fusarium nivale*, *Fusarium semitectum*, *Drechslera hawaiiensis*, and *Alternaria alternata* comparing with Ridomil Gold (MZ 68% WP). The oils extracted from all seeds except mustard showed a variation of the degree of fungicidal activity against experimental species. *Asafoetida* oil considerably inhibited the growth of all test fungi except.^[16] The antifungal and allelopathic effects of the various concentrations of methanolic extract of *Asafoetida* oleo-gum-resin against *Pleurotus* spp. and *Trichoderma harzianum* and were evaluated in dual culture experiments on an agar medium. It exhibited fungistatic and fungicidal properties against *T. harzianum* and *Pleurotus* spp. at the higher concentrations.^[42] The different concentrations of formulations containing neem oil, nicotinic acid and *F. asafoetida* with α , and β -unsaturated carbonyl compounds were evaluated for *in vitro* screening against *Sclerotium rolfsii* ITCC 5226 and *Macrophomina phaseolina* ITCC 0482. These formulations with *F. asafoetida* at a dose level of 66 mg/L as a natural product may be an useful new another approach to control pathogenic fungi.^[15,43] Mostafa *et al.* noticed the antifungal effect of essential oil from *Asafoetida* seed on some of the plant pathogenic fungi including *Bipolaris sorokiniana*, *Fusarium graminearum*, *Verticillium* sp., *A. niger*, and *Fusarium solani* based on an entirely randomized design using *in vitro* method. The essential oil from *Asafoetida* seed compared with controls significantly inhibited the growth of all tested fungal species. *B. sorokiniana* growth totally inhibited by essential oil from *Asafoetida* seed, but inhibiting effect of other species was extremely dose dependent. El Deeb *et al.*, 2012 evaluated the activity of *Asafoetida* against the *in vitro* growth of *Blastocystis* sp. Both oil and powder form of *Asafoetida* extracts were incubated with isolates of

Blastocystis sp. subtype 3 comparing with antiprotozoan metronidazole as standard drug. Both oil and powder form of *Asafoetida* reduced counts and viability of all tested isolates of *Blastocystis* sp. subtype 3. The degree of the inhibitory action was extremely dependent on the concentration, form and time of incubation with *Asafoetida* extracts. The lowest concentration of both powder and oil form of *Asafoetida* that caused complete inhibition of *Blastocystis* growth and maximum percentage inhibition of development was 16 and 40 mg/mL, respectively. *Asafoetida* can potentially be used as a potent natural alternative phytomedicine for the treatment of *Blastocystis* sp. infection.^[44]

Antifertility Activity

It has been reported that post-coital antifertility activities were shown by various extracts of *F. asafoetida*. Keshri *et al.* found that the methanolic extract of *F. asafoetida* resin at a dose of 400 mg/kg daily prevented post-coitus pregnancy, in 80% of adult Sprague-Dawley rats up to days 1-10 duration. It has also been observed that the said dose inhibits pregnancy in 100% of the rats when administered in the mixture with polyvinylpyrrolidone.^[45]

Hepatoprotective Activity

Dandagi *et al.* reported the hepatoprotective activity of different extracts such as those of *F. asafoetida*, *Momordica charantia* Linn, and *Nardostachys jatamansi* against experimentally induced hepatotoxicity. The extracts of benzene, chloroform, petroleum ether (60-80), ethanol, and aqueous of *F. asafoetida*, *M. charantia* Linn, and *N. jatamansi* were evaluated against carbon tetrachloride-induced liver toxicity in Wistar rats for their respective hepatoprotective activities. Polyhedral suspensions of the above mentioned extracts were prepared and then respective hepatoprotective activities were screened by determining the levels of serum enzymes such as glutamate pyruvate transaminase, glutamate oxaloacetate transaminase, and alkaline phosphatase. It was also distinguished that administration of polyhedral suspension reduced the serum enzyme levels. The biochemical observations were further supplemented by the histopathological examinations of liver sections. The experimental data indicated that polyhedral suspension of the extracts exhibited promising activity against the carbon tetrachloride-induced hepatotoxicity.^[46]

Antiulcer Activity

The evaluated the antiulcer activity of aqueous suspension from *Asafoetida* prepared in 1% carboxymethyl cellulose in water on various ulcer induced models of Wistar albino rats. Gastric ulceration was induced by pylorus ligation in rats comparing with indomethacin used as standard and induction of gastric lesions by narcotizing 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 a histopathological assessment of gastric tissue and by determination of gastric wall mucus (GWM) contents of the stomach as these parameters exhibited enhanced protection of various indices and by replenishing the depleted GWM level by suspension treatment.^[47,48]

Memory Enhancing Activity

Manifestations of loss of memory are the primary symptom in most of the people suffering from Alzheimer's disease around the world. Vijayalakshmi *et al.*, 2012 evaluated the effect of the *F. asafoetida* extracts on learning and memory in rats.^[49] The memorization and learning were evaluated using elevated plus maze and passive avoidance paradigm after administering two oral doses (200 and 400 mg/kg) of *F. asafoetida* aqueous extract with rivastigmine as a positive control. The extract produced a significant improvement in memory score and a dose-dependent improvement of transfer latency in elevated plus maze model. The significant improvement in antioxidant properties and dose-dependent inhibition of brain cholinesterase was also observed. Memory enhancing the potential of *F. asafoetida* can be allocated to acetylcholinesterase inhibiting and antioxidant properties. *F. asafoetida* can also be employed as an adjuvant to existing antidementia therapies. Bagheri *et al.*, 2015 investigated the effect of *Asafoetida* on preventive treatment of dementia which may be induced by D-galactose and NaNO₂ in mice. Animals were divided into four different groups such as normal control (NC), dementia control (DC), dementia prophylactic (DP), and dementia treated (DT). The groups DP, NC, and DT were appreciably shown superior memory retention capability than the DC group. *Asafoetida* could prevent and treat amnesia which may be explained by the presence of bioactive compounds containing sulfur and sesquiterpene coumarins.^[50] The antiepileptic and antioxidant properties of the *F. asafoetida* gum extract, utilizing the pentylenetetrazole (PTZ) kindling method. The significant reduction of MDA and NO levels and raised the SOD level after administration of plant extracts treated groups compared to the PTZ group. *F. asafoetida* gum extract probably causes a decrease in oxidative damage and lipid peroxidation due to its antioxidant properties. The lowering effects of hydroalcoholic *F. asafoetida* gum extracts on the PTZ-induced seizures are probably, because of its antioxidant properties and decrease of oxidative stress.

Digestive Enzyme Activity

In general, the spices have strengthened salivary flow and gastric juice secretion and support in the digestion process, due to enzymatic participation in digestion. Some common spices or active principles were evaluated for their probable influence on digestive enzymes of the pancreas in experimental rats. The animal groups were kept for 8 weeks on the following the spice diets are curcumin (0.5 mg), capsaicin (15 mg), piperine (20 mg), ginger (50 mg),

cumin (1.25 mg) fenugreek (2 mg), mustard (250 mg), and *Asafoetida* (250 mg). Among these spices, *Asafoetida* significantly enhanced pancreatic lipase activity and also stimulated pancreatic amylase. The positive impact of the pancreatic digestive enzymes exerted by a good number of spices consumed in the diet could be a factor contributing to the well-recognized digestive stimulant action of spices.^[11] Rao *et al.* also examined the *in vitro* influence of 14 spices along with *Asafoetida* on the effects of digestive enzymes of rat pancreas and small intestine including them in the reaction blend of two dissimilar concentrations. A majority of spices improved the activity of pancreatic lipase and amylase when they are directly influencing the enzyme.^[51]

Anxiolytic Effect and Anthelmintic Activity

Alqasoumi 2012 discussed the analgesic, sedative and anxiolytic activities of *Asafoetida* in rodents, using hot plate, motor activity meter, and elevated plus maze. Diazepam was used as a standard anxiolytic agent. The results have shown a dose-dependent anxiolytic and analgesic activity of *Asafoetida* with a calm sedative result in high doses. The *Asafoetida* seems to be a better option for the cure of anxiety disorders. Low doses of *Asafoetida* can be a therapeutic alternative to the presently used anxiolytic drugs.^[52,53]

Gundamaraju 2013 evaluated the anthelmintic activity of three different concentrations of aqueous extract of *F. asafetida* against *Pheretima posthuma* that involved the determination of time of paralysis and death of the worm. The extract has shown significant anthelmintic activity at the highest concentration of 100 mg/mL. It has also shown better expressive activity than the standard drug of piperazine citrate.^[54] Kumar and Singh studied the effect of dried *Allium sativum* clove powder. *F. asafetida* dried latex powder and flower but dried powder of *Syzygium aromaticum* in the management of liver fluke *Fasciola gigantica*. All the three plants were evaluated for anthelmintic activities at the same time-concentration and time dependent. Ethanol extract was more toxic than other organic extracts. Ethanol extract of *F. asafetida* was highly toxic against *F. gigantica*. The dried root latex powder of *F. asafetida* can be invoked as potent helminthicide.

BIOLOGICAL ACTIVITIES REPORTED FROM THE BIOACTIVE COUMARINS OF ASAFOETIDA

The pharmacological activities of some main chemical constituents from *Asafoetida* have been proved by various studies of researchers and found significant in prevention and control of various diseases or disease conditions.

a. Umbelliprenin has anti-inflammatory, apoptosis inducer (melanoma cell line), 5-lipoxygenase inhibitor, antileishmanial action, cancer chemopreventive (*in vitro*

and *in vivo*), and depigmentation of bacteria (*Serratia marcescens*).

- b. 8-acetoxy-5-hydroxyumbelliprenin has antiviral (influenza H1N1), NF- B inhibitor action.
- c. 10-R-acetoxy-11 hydroxyumbelliprenin has antiviral (influenza H1N1) activity.^[7]
- d. Epi-conferdione has antiviral (influenza H1N1).^[7]
- e. Conferol has antiviral (influenza H1N1), cytotoxic (HepG2, Hep3B, and MCF-7), synergistic effect with anticancer agents (vincristine).^[7,55]
- f. Farnesiferol A has antiviral (influenza H1N1) action.^[7]
- g. Farnesiferol B has antiviral (influenza H1N1, HRV-2).^[7,14]
- h. Farnesiferol C antiviral (influenza H1N1, HRV-2), antitumor, and antiangiogenic.
- i. Ferulic acid has anticoagulant, molluscicidal, antioxidant (as sodium ferulate), anti-atherosclerotic, cancer chemopreventive, neuroprotective, angiogenesis inducer, vasodilator, antigenotoxic, and hypoglycemic.^[56,57]
- j. Galbanic acid has antiviral (influenza H1N1, HRV-2), antileishmanial, and bacterial resistance modulator (*Staphylococcus aureus*).^[7,58]
- k. Umbelliferone antioxidant, molluscicidal, antihyperlipidemic, antihyperglycemic, and angioedema.^[59,60]

ADVERSE EFFECT

A methemoglobinemia has been observed after ingestion of *Asafoetida* in a 5 week old black male infant. He was found by the action of intravenous methylene blue from onset of tachypnea, grunting, and cyanosis.^[61] The large dose intake of *Asafetida* may lead to bulging in the mouth, a digestive complaints such as diarrhea and flatulence, nervousness, and headache. Intake of *Asafetida* is safe to prescribe during the pregnancy.^[62]

CONCLUSION

On the basis of the literature, *Asafetida* can be used as different medicines by its pharmacological activities. *Asafoetida* traditionally is greatly employed for the treatment of a variety of diseases. It is also widely used all over the world as an odor spice in different foodstuff. It is used as a management of several problems such as unwanted abortion, unusual pain, sterility, and particularly ailment for women such as difficult and excessive menstruation, and leukorrhea. In recent pharmacological studies have also shown that *Asafoetida* acquires numerous activities such as a relaxant, neuroprotective, memory enhancing, digestive enzyme, antioxidant, antispasmodic, hypotensive, hepatoprotective, antimicrobial, anticancer, anthelmintic, and another therapeutic effect. Even though *Asafoetida* has amazing medicinal significance but detailed studies to search new chemical constituents are also immensely needed.

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