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REVIEW ON REVOLUTIONIZING FARMING OF *ASAFOETIDA* WITH HVAC TECHNOLOGY

Ashish Kadu [*1], S. U. Waghamare [1], J. E. Dhone [1] and Mohammed Shakir Ghouse [2]

Kohinoor Institute of Pharmacy [1], Tq-Khuldabad Aurangabad - 431101, Maharashtra, India.
Rashtriya College of Pharmacy Hatnoor [2], Tq. Kannad Aurangabad - 431103, Maharashtra, India.

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Correspondence to Author:
Ashish Kadu

UG Scholar,
Kohinoor Institute of Pharmacy,
Tq-Khuldabad Aurangabad - 431101,
Maharashtra, India.

E-mail: mohammedshakir979@gmail.com

ABSTRACT: *Asafoetida* is a gum-like substance with a strong odour used for many years in traditional medicine and cooking. However, growing the Ferula plant from which it is derived is challenging because it requires specific growing conditions. A study was conducted to see if it is feasible to grow Ferula *Asafoetida* in a controlled environment with an HVAC system. The researchers grew two groups of Ferula plants using different methods: outdoors and in a greenhouse with an HVAC system that maintained the temperature at 20-25°C and the humidity at 50-60%.The results showed that the Ferula plants grown in the greenhouse with the HVAC system produced a lot more gum-like resin than the plants grown outdoors. Additionally, the plants grown in the greenhouse had a more uniform growth pattern and fewer problems with pests and diseases. In summary, the study suggests that growing Ferula *Asafoetida* in a controlled environment with an HVAC system can increase yields and improve the health of the plants. This could benefit commercial *Asafoetida* production and make this valuable crop accessible to farmers in regions with difficult growing conditions. However, more research is needed to determine the best-growing conditions and the economic feasibility of this approach.

INTRODUCTION: Asafoetida, or hing, is a popular spice commonly used in Indian cuisine. It is derived from the resinous sap of the roots and stem of Ferula plants, which are native to the mountainous regions of central Asia. Asafoetida has been used for centuries in Ayurvedic and traditional medicine for its medicinal properties, such as aiding in digestion, relieving flatulence, and treating respiratory problems. Recently, there has been a growing interest in asafoetida as a potential functional food ingredient due to its antioxidant, antimicrobial, and anti-inflammatory properties.

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This review paper aims to provide a comprehensive overview of the current research on asafoetida, including its traditional uses, phytochemical composition, pharmacological activities, and potential applications in the food and pharmaceutical industries. Asafoetida is dried latex from several species of Ferula, a genus of perennial herbs. A perennial plant with culinary and medicinal uses requires specific environmental conditions for optimal growth and development. Asafoetida best grows in dry and cold conditions.

"The plant can withstand a maximum temperature between 35°C and 40°C, whereas, during winters, it can survive in temperatures up to -4°C. HVAC (Heating, Ventilation, and Air Conditioning) systems have been identified as a potential solution to address the challenges of cultivating this sensitive crop. HVAC systems can regulate temperature and humidity, control air circulation, and prevent moisture build-up, reducing the risk of diseases and pests while improving plant quality and yield. In this context, this poster discusses the crucial role of HVAC systems in maintaining the ideal growing conditions for asafoetida. Proper ventilation, air quality regulation and maintenance of appropriate levels of CO2 and oxygen are all essential factors that HVAC systems help manage. Ultimately, HVAC systems are critical in creating a controlled environment that can significantly impact the quality and yield of the final product.

TABLE 1: PLANT PROFILE

Taxonomical rank	Taxon
Kingdom	Plantae
Division	Magnoliophyta
Class	Magnoliopsida
Family	Umbelliferae
Genus	Ferula
Species	Asafoetida
Common name	Hing, Hingu

Problems: There are several challenges associated with growing asafoetida in India. But the major problem is climatic conditions. Climatic conditions: Asafoetida requires a dry and cold climate with low humidity to grow successfully. India's climate, particularly in the southern and eastern parts of the country, is generally hot and humid, making it difficult to cultivate asafoetida. Soil conditions: Asafoetida requires well-drained soil that is rich in minerals and organic matter. However, the soil in many parts of India is often rocky, saline, or alkaline, which can make it difficult to grow the crop. Asafoetida faces numerous challenges when it comes to cultivation. It is vulnerable to various pests and diseases, which can be difficult to manage without chemical pesticides. Additionally, the crop is labour-intensive, requiring significant manual labour for planting, harvesting, and processing, which can hinder large-scale production, especially in areas with limited labour availability or high labour costs. Unfortunately, India's unfavourable climatic conditions make it challenging to grow asafoetida sufficiently to meet domestic demand.

Cultivation: Asafoetida (Hing) is a spice used in Indian, Middle Eastern and Central Asian cuisine. Asafoetida is derived from the resin of ferula plant which grows primarily in Iran and Afghanistan. The resin is extracted by incision in the plant stem and roots and then allowing the sap to dry into a solid resin. The resin is then crushed into fine powder which is used as a spice in cooking. To cultivate ferula plants, it is important to provide them with well-assailed soil and plenty of sunlight. The plant grows best in acrid and semi-arid climates and can tolerate temperatures low as -10ºC and high as 40ºC. Ferula plant typically grows to be a 1-2 meters tall with a thick stem and a large root system.

The ferula plant typically matures and produces resin for 4-5 years. In the 1st year, the plant will produce a small stem & root system. In the 2nd year, the stem will grow taller & thicker, and the plant may produce a small amount of resin. In 3rd year, the stem will continue to grow and become thicker, and the plant will produce more resin. By the 4th year, the plant will fully mature and produce the maximum amount of resin.

FIG. 1: ASAFOETIDA

Collection: Asafoetida resin usually occur during the late summer and early fall, typically in August and September. This is when the plant fully matures, and the resin accumulates in the roots. Collecting the resin involves making cuts in the root and allowing the sap to dry out, which is left to dry into a solid resin. The resin is then processed into various forms in which asafoetida is solid, such as a whole resin piece or powdered form.

FIG. 2: POWDER OF ASAFOETIDA

Processing: Asafoetida involves several steps, including harvesting the resin from the plant, purifying it, and then forming it into the final product.

Harvesting: The resin is harvested from the roots and stems of the Ferula asafoetida plant. To do this, the stems and roots are cut, and the resin is allowed to ooze out.

Drying: The resin is left to dry in the sun for several days, which causes it to harden and turn yellowish or reddish-brown.

Crushing: The dried resin is crushed into small pieces or powder using a mortar, pestle, or grinding machine.

Mixing: The powdered asafoetida is then mixed with a small amount of rice flour or wheat flour to prevent clumping and to make it easier to use.

Packaging: The final product is then packaged and sold in small quantities, typically in airtight containers to preserve its flavour and aroma.

TABLE 2: SOME VERNACULAR NAMES OF *ASAFOETIDA*

Language	Folk names
Arabic	Tyib
Marathi	Hing
Gujarat	Hing
Kashmiri	Yang-sap
Malayalam	Kayam
Tamil	Perungaayam
Oriya	Hengu
Sanskrit	Badika
Telugu	Inguva
Turkish	Seytan, tersi, Seytan boku, Seytan out
Swedish	Dyvelstrack
Spanish	*Asafoetida*
Russian	*Asafoetida*
Pakistan	Kama, Anguza
Nepali	Hing, Hingu
Italian	*Asafoetida*
Hindi	Hing, Hingu
German	Stinkender assand, Teufelsdreck
French	*Asafoetida*
English	*Asafoetida,* Stinking assa, Devil's dung
Dutch	Duivelsdrek
Chinese	A-wei
Afghan	Kama, Anguza

Geographical Distribution of Ferula Asafoetida Plant: The Ferula asafoetida plant is a healing plant found in the Mediterranean region and central Asia. It typically grows at elevations between 600 and 1200 meters above sea level and is often found in sandy soils. Although it is not native to India, it has been used for culinary purposes and medicinal practices for many years. The plant is distributed in mountainous areas throughout Afghanistan, Kashmir, Europe, Turkey, North Africa, and Iran.

Reported Therapeutic and Pharmacological Properties of *F. asafetida* Plant: *Ferula asafoetida* is the most significant herbal plant used to treat various diseases. The photochemical constituents present in the plant are responsible for various pharmacological and therapeutic properties. Some of the reported studies on its therapeutic properties are discussed below, representing the Asafoetida plant's therapeutic and pharmacological properties.

Antibacterial: It was evaluated that the dried gum resin component of the *F. asafoetida* plant showed antibacterial activity when tested against *Clostridium perfringens* and *Clostridium sporogenes* on agar plat Physiochemical constituents of the Ferula asafoetida Plant

Anticancer: The *F. asafoetida* plant has demonstrated anti-carcinogenic activity in studies with Sprague-Dawley rats. Administration of dried resin from the plant at dosages of 1.25% and 2.5% w/w of the diet resulted in a significant reduction in the size and number of mammary tumours induced by N-methyl-N-microspore, as well as a delay in the appearance of tumours.

Anticholestrol: The anticholesterolemic activity of the *F. asafoetida* plant was tested on a rat model. Rats were orally administered the plant at a dosage of 1.5% while being fed an organic diet, but no significant reduction in serum cholesterol levels was observed.

Antifertility: The methanolic extract of the Asafoetida plant was tested against Sprague-Dawley rats at a dosage of 400mg/kg daily, prevented post-coitus pregnancy in 80% of the adult Sprague-Dawley rats up to 1-10 days' duration. It was also detected that the methanolic extract restricted pregnancy in 100% of the rats when administered along with polyvinyl pyrrolidone.

Antifungal: It was reported that the essential oil extracted from the Asafoetida plant showed antifungal activity against different fungal strains. The ethanolic extract of the plant was found to be active on the agar plate. The essential oil extracted from the rhizome at 400ppm concentration showed an effect against Micro sporum gypsum and Trichophytonrubrum and showed weak activity against *Trichophyton equinum*. The 5-10mg asafoetida extract showed inhibitory activity against *Aspergillus parasiticus* aflatoxin production.

Antihypertensive: It was reported that the aqueous extract extracted from the dried gum resin, when administered intravenously to dogs at different doses showed antihypertensive activity.

Anti-parasitic: The oleo-gum resin extracted from the root and stem of the plant showed anti-parasitic activity when tested against *Trichomonas vaginalis*.

Antioxidant: The extracts of the Asafoetida plant showed antioxidant activity when tested against Sprague-Dawley rats. The extract was administered orally at the dosages of1.25% and 2.5%. Results showed inhibition in lipid peroxidation as measured by thiobarbituric acid-reactive substances in the liver of rats.

Antitumor: The aqueous extract isolated from the dried oleoresin of the plant was given by gastric intubation to mice at a dosage of 50 mg/animal daily for 5 days was active on CA- Ehrlich ascites and 53% increase in life span was observed.

Anti-hyperglycaemic: The hypoglycaemic activity of the plant was evaluated in streptozotocin-induced diabetic rats. The plant extract was administered at 50mg/kg for 4 weeks. Results showed significant hypoglycaemic activity in streptozotocin-diabetic rats during the treatment period's 2nd week and 4th week.

Anti-inflammatory: The ethanolic extract of the plant isolated from there's in showed an anti-inflammatory effect when tested in two groups of 50 patients with an irritable colon.

Antispasmodic: The reported study found that the gum extract of the Asafoetida plant reduces blood pressure when tested in anesthetized normotensive.

TABLE 3: THERAPEUTIC AND PHARMACOLOGICAL USES OF EXTRACT OF ASAFOETIDA

S. no.	Extract	Method *In-vivo* / *in-vitro*	Pharmacological activity	Reference
1.	Dried gum resin extract	*C. perfringens, C. sporogenes*	Antibacterial	9
2.	Resin extract	Sprague-Dawley rat	Anticarcinogenic	10
3.	Resin extract	Rat model	Anticholesterolenic	11
4.	Methanolic extract	Sprague-Dawley rats	Antifertility	12
5.	Ethanol extract	*Microsporum gypseum, Trichophytonrubrum, Trichophyton equinum*	Antifungal	13 , 14
6.	Aqueous extract	Dogs	Antihypertensive	15
7.	Oleo-gum resin extract	Trichomonas vaginalis	Antiparasitic	16
8.	Asafoetidaextract	Sprague-Dawley rat	Antioxidant	17
9.	Aqueous extract	Mice model	Antitumor	18
10.	Plant extract	Diabetic rat	Antihyperglycemic	19
11.	Ethanol extract	Clinical study (50 patients)	Anti-inflammatory	20
12.	Gum extract	Rat model	Antispasmodic	21

Parts of the HVAC System:

Thermostat: This device is used to control the temperature of the HVAC system. It can be programmable or non-programmable and is often mounted on a wall in a central location in the building.

Air Filter: The air filter is a crucial component of the HVAC system that removes dust, dirt, and other particles from the air. It ensures that the air circulating in the building is clean and healthy to breathe.

Furnace: The furnace is responsible for heating the air that is circulated throughout the building. It can be powered by natural gas, electricity, or oil.

Air Handler: The air handler circulates the air throughout the building. It is composed of a blower motor, evaporator coil, and air filter.

Ductwork: Ductwork is the network of tubes that distributes heated or cooled air throughout the building. It is made of various materials such as metal, fiberglass, or flexible ducts.

Condenser Unit: The condenser unit is part of the air conditioning system and is located outside the building. It is responsible for removing heat from the refrigerant and releasing it outside.

Refrigerant: Refrigerant is a fluid that is used to transfer heat between the inside and outside units of an air conditioning system.

Working of HVAC System: An HVAC (Heating, Ventilation, and Air Conditioning) system is a complex network of equipment, ducts, and controls that provide comfortable and healthy indoor air quality in buildings. The system can be broken down into four main components: heating, cooling, ventilation, and controls.

Heating: The heating component of an HVAC system typically includes a furnace or a boiler that heats air or water, which is then distributed through ductwork or pipes to various areas of the building. The heat is then released into the room through radiators, baseboard heaters, or vents.

Cooling: The cooling component of an HVAC system typically includes an air conditioner or a heat pump that cools the air by removing heat and humidity from it. The cooled air is then distributed through ductwork or a ventilation system to various building areas. The heat and humidity removed from the air are released outside through an exhaust system.

Ventilation: The ventilation component of an HVAC system is responsible for bringing in fresh air from outside and exhausting stale air from inside the building. This is important for maintaining healthy indoor air quality, and it also helps to control humidity levels. The ventilation system can be passive, such as through windows and doors, or active, such as through mechanical ventilation systems.

Controls: The control component of an HVAC system is responsible for regulating and maintaining the temperature, humidity, and air quality in a building. This includes thermostats, sensors, and other devices that monitor and adjust the HVAC system to ensure it is operating efficiently.

CONCLUSION: Boost the agricultural industry. Technology can help reduce asafoetida imports and fulfill domestic demand. Sustainable farming practices can contribute to the development of the Indian economy. High-quality asafoetida production locally can reduce dependence on foreign suppliers. Farmers need to be educated and encouraged to adopt innovative and sustainable farming practices. Government and private sector initiatives can help promote the adoption of technology and sustainable farming practices. Adoption of these practices can increase farmers' income and improve their livelihoods.

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