

# **Ferula assa-foetida as a main medical plant in east of Iran (harvesting, main characteristics and economical importance)**

Farhood Golmohammadi<sup>1\*</sup>, Seyyed Esmaeel Ghoreyshi<sup>2</sup> and Hassan Parvaneh<sup>3</sup>

1. assistant professor, Department of Agricultural Extension and Education, Islamic Azad University– Birjand Branch – Birjand. IRAN.
2. staff member and Management Expert in Natural Resources and Watershed Administration of Tabas city in south Khorasan province, Iran.
3. staff member and Management Expert in Natural Resources and Watershed Administration of Birjand city in south Khorasan province, Iran.

**Corresponding author:** Farhood Golmohammadi

**ABSTRACT:** Many people in Mediterranean region who consult with spiritual healers, homeopaths and herbalists are utilizing traditional therapies. These are the first choice for problems such as liver diseases, inflammation, skin diseases, infertility, impotence, diabetes, obesity, epilepsy, psychosomatic troubles, and many other diseases. The demand for medicinal plants has increased globally due to the resurgence of interest in and acceptance of herbal medicine. Most of the demand is being met through collection of large quantities of medicinal plants and plant parts from wild populations. The methods of extraction employed are almost invariably crude and unsystematic. As a consequence, the rates of exploitation may exceed those of local natural regeneration. *Ferula assa-foetida* L. (Apiaceae) is a medicinal plant indigenous to Iran and Afghanistan. This plant is one of the most important among the thirty species of *Ferula* distributed in Iran. It is an herbaceous and perennial plant that grows up to 2 m high. One part used is an oleo-gum resin, called asa-foetida or anghoze in Persian, obtained by incision from the roots. It has been reported in Iranian folk medicine to be antispasmodic, aromatic, carminative, digestive, expectorant, laxative, sedative, nerving, analgesic, anthelmintic, aphrodisiac and antiseptic. Iran is one of the most important producers of this plant in the world. Also *Ferula* is one of the most important endangered medicinal plants, which is rare in nature due to poor seed germination. In this article author introduce his field, qualitative and participatory study on harvesting, main characteristics and economical importance of this valuable medicinal plant in south-khorasan province, east of Iran as a major producer and exporter.

**Keywords:** Ferula, harvesting, medical plant, economic, south Khorasan province, Iran.

## **INTRODUCTION**

Medicinal plants are an important element of medical system. These resources are usually regarded as part of cultural traditional knowledge (Golmohammadi, 2013). The genus *Ferula* belongs to Umbelliferae family consists of 140 species which are widespread from Mediterranean region to central Asia. *Ferula assa-foetida* L. is one of the most important species of this genus that is native to Iran and Afghanistan, and commonly known as asafoetida. It is herbaceous, monoecious and perennial plant that grows up to 2m height, and is in two types, bitter and sweet (Iranshahy and Iranshahi, 2011).

*Ferula assa-foetida* L. (Apiaceae) is a medicinal plant indigenous to Iran and Afghanistan. This plant is one of the most important among the thirty species of *Ferula* distributed in Iran. It is an herbaceous and perennial plant that grows up to 2 m high. One part used is an oleo-gum resin, called asa-foetida or anghouzeh in Persian, obtained by incision from the roots. It has been reported in Iranian folk medicine to be antispasmodic, aromatic, carminative, digestive, expectorant, laxative, sedative, nervine, analgesic, anthelmintic, aphrodisiac and antiseptic.

Asafoetida's English and scientific name is derived from the Persian word for resin (*asa*) and Latin *foetida*, which refers to its strong sulfurous odour. Its pungent odour has resulted in its being called by many unpleasant names; thus in French it is known (among other names) as *merde du diable* (devil's faeces); in some dialects of English, too, it was known as *devil's dung*, and equivalent names can be found in most Germanic languages (e.g. German *Teufelsdreck*, Swedish *djvelsträck*, Dutch *duivelsdrek*, Afrikaans *duiwelsdrek*), also in Finnish *pirunpaska* or *pirunpihka*. In Turkish, it is known as *şeytanti* (devil's sweat), *şeytan boku* (devil's shit) or *şeytanotu* (the devil's herb) (HASSANI et al., 2009).

Medicinal plant collectors are usually poor villagers. Plant collection is their part time activity besides farming and live stock keeping (Hamayun et al., 2003).

This situation also has been seen in plant collectors that are usually poor villagers and medicinal plant collection is their part time activity besides farming and livestock keeping in villages of South Khorasan province (Figures 1 & 2 & 3 & 4 & 5 & 6).





Figures 1 & 2 & 3 & 4 & 5 & 6: author presence among medicinal plant collectors that are usually poor villagers and plant collection is their part time activity besides farming and herds keeping. Mavdar and Sorond villages of Tabas City, 300 km. distance to Birjand, centre of South Khorasan province (May 23, 2016).

Table 1: names of *Ferula assa Foetida* in different languages

Persian	English	French	German	Hindi	Arabic	Botanical name	Family
Anghorse	Stinking assa	Stinkender assand	Teufels treck stinkender assand	Hing, Hingra	Zallouh	<i>Ferula assa – foetida</i>	Apiaceae

(Golmohammadi, 2013).

Table 2: some of the meteorology, geology and botanical information of growth regions of *Ferula assa Foetida* in south khorasan province

Average amount of rainfall in province (2005-2016)	81/03 millimeters
Maximum temperature ( in June and July months)	46.59 centigrade
Minimum temperature ( in December and January months)	-2.11 centigrade
Time that need for maturing <i>Ferula assa Foetida</i> shrubs and producing gum	5 years
Time of growth of <i>Ferula assa Foetida</i> shrubs	From end of winter until end of June
Time of dormancy of immature <i>Ferula assa Foetida</i> shrubs	From beginning of July until end of winter
Main type of lands that <i>Ferula</i> can growth	Sandy and lime
Main locations that <i>Ferula</i> can growth	Mountains and pastures
Main type of reproducing of <i>Ferula</i>	Only by seed
Average rainfall that need for growth of <i>Ferula</i> shrubs	90 – 150 millimeters
Slope of growth regions of <i>Ferula</i> shrubs	30-60 percent
Main origin regions of <i>Ferula</i> shrubs	Iran and Afghanistan

Acreage of potential pasture areas for producing medicinal fresh gum of <i>Ferula assa Foetida</i>	100000 ha
Number of rural households that their income are dependent on <i>Ferula</i>	2000

(Information and Statistical Department, 2016).

**Table 3: some of the economic information of *Ferula assa Foetida* in south khorasan province**

Amount of medicinal fresh gum that produce from one shrub of <i>Ferula assa Foetida</i>	20-40 grams
Value of annually exporting dried gum of <i>Ferula assa Foetida</i>	4000000 \$ USD
Total amount of dried gum of <i>Ferula assa Foetida</i> in rainy years	60 tons
Amount of dried gum of <i>Ferula assa Foetida</i> in dried years	15-20 tons
Main cities that producing medicinal fresh gum of <i>Ferula assa Foetida</i> in their pasture areas	Tabas, Qaen, ferdows, boshrooyeh
Value of one kg. dried gum of <i>Ferula</i> in global markets	130-170 \$ USD
Value of one kg. dried gum of <i>Ferula assa Foetida</i> that buy by middlemen from native medicinal plant collectors (in 2016)	60-70 \$ USD
Value of one kg. dried stem of <i>Ferula assa Foetida</i> that buy by middlemen from native medicinal plant collectors (in 2016)	25-30 \$ USD
Selecting shrubs of <i>Ferula</i> that ready for catching its gum and marking on them by rural people	April and November
harvesting gum for supplying to market	June, July and August
sowing seeds of <i>Ferula assa Foetida</i> by rural people	winter
new germinating shrubs of <i>Ferula assa Foetida</i> plants	End of winter and beginning of spring
Main pests of <i>Ferula assa Foetida</i> shrubs	Desert mice, one type of worm, and grasshopper
Main targeted global markets for exporting dried gum of <i>Ferula assa Foetida</i>	India, Europe Union, and Arab countries around the Persian Gulf
Percent of dried gum that each year exported to global markets	Approximately 100 %*
Main type consumption of dried gum of <i>Ferula assa Foetida</i>	Medicinal factories
Number of Medicinal factories in south khorasan province	zero
Years that need for producing seeds by shrub of <i>Ferula assa Foetida</i>	4 -5 years
times that each shrub of <i>Ferula assa Foetida</i> can produce seeds in his life period	One time **

\*Consumption of dried gum among locally people is very limited and mainly in medicinal plants shops.

\*\* each shrub of *Ferula assa Foetida* after producing seeds will be died because of using all of its fresh gum.  
(Information and Statistical Department, 2016).



Figures 7& 8 & 9 & 10 & 11& 12 & 13 & 14: Shrubs of *Ferula assa Foetida* in mountains and pasturelands of south Khorasan province in different stages of their growing (by author. 2012 & 2013).

2.various stages for harvesting *Ferula* gum, plus producing and sowing its seeds

*Ferula assa Foetida* grows to 2 meters high, with a circular mass of 30–40 cm leaves. Stem leaves have wide sheathing petioles. Flowering stems are 2.5–3 meters high and 10 cm thick and hollow, with a number of schizogenesis ducts in the cortex containing the resinous gum. Flowers are pale greenish yellow produced in large compound umbels. Fruits are oval, flat, thin, reddish brown and have a milky juice. Roots are thick, massive, and pulpy. They yield a resin similar to that of the stems. All parts of the plant have the distinctive fetid smell.

The resin-like gum comes from the dried sap extracted from the stem and roots and is used as a spice. The resin is grayish-white when fresh but dries to a dark amber color. The asafoetida resin is difficult to grate and is traditionally crushed between stones or with a hammer. Today, the most commonly available form is compounded asafoetida, a fine powder containing 30% asafoetida resin, along with rice flour and gum Arabic.

*Ferula assa Foetida* is exudates which are obtained by tapping the root stock of the plant. The root of plants have been used for their perceived anthelmintic, antimicrobial, antispasmodic, aromatic, laxative, antispasmodic, diuretic and antiseptic actions in folk medicine.

*Ferula assa-foetida* L. (Apiaceae) is one of the most important endangered medicinal plants, which is rare in nature due to poor seed germination. Although the flora of Persia is thus fairly well known, there are still very few works on its overall vegetation (Information and Statistical Department, 2016) & (Golmohammadi, 2013).

In this regard, various stages for harvesting and catching *Ferula* gum are as following:

A) Selecting shrubs of *Ferula assa Foetida* that ready for catching its medicinal gum and marking on them by rural people in April and November (figures 7-14);

B) Fencing of stones around these selected shrubs (figures 12 & 15-22);

C) harvesting its gum - final stage for producing dried gum for supplying to market- in June, July and August. In this stage in each 4-5 days in these months, native medicinal plant collectors by their traditional tools (figures 23-25) create a thin cutting on the stem and after this time period, gathering resin-like gum that oozing by plant in the place of cutting stem, and then again replicating this process in 12-16 rounds each 4-5 days on the stems of *Ferula* in these months (figures 15-22);

Plus gathering its gum, then thin cutting stems of *Ferula* shrubs by native medicinal plant collectors in above 12-16 rounds will be gathered and dried by them and present as dried cutting stems of *Ferula assa* (Keshteh - in endemic Persian language) for supplying to market and processing by foreign medicinal factories (figures 32-35);

Each skillful native medicinal plant collectors in one day can cut stems of 1000 *Ferula* shrubs and gathering 4-10 grams of resin-like gum from each cutting stems in 4-5 days ago. This means that a skillful native medicinal plant collector can obtain 2-3 kg. gum from *Ferula* shrubs in good and rainy seasons in these months of harvesting (figures 15-22 & 32-35);

D) producing seeds from shrub of *Ferula assa Foetida* that ready for this in end of summer;

E) sowing seeds of *Ferula assa Foetida* by rural people in winter and beginning a new germinating shrub of plant in the end of winter and beginning of spring (figures 26-31) (Information and Statistical Department, 2016).



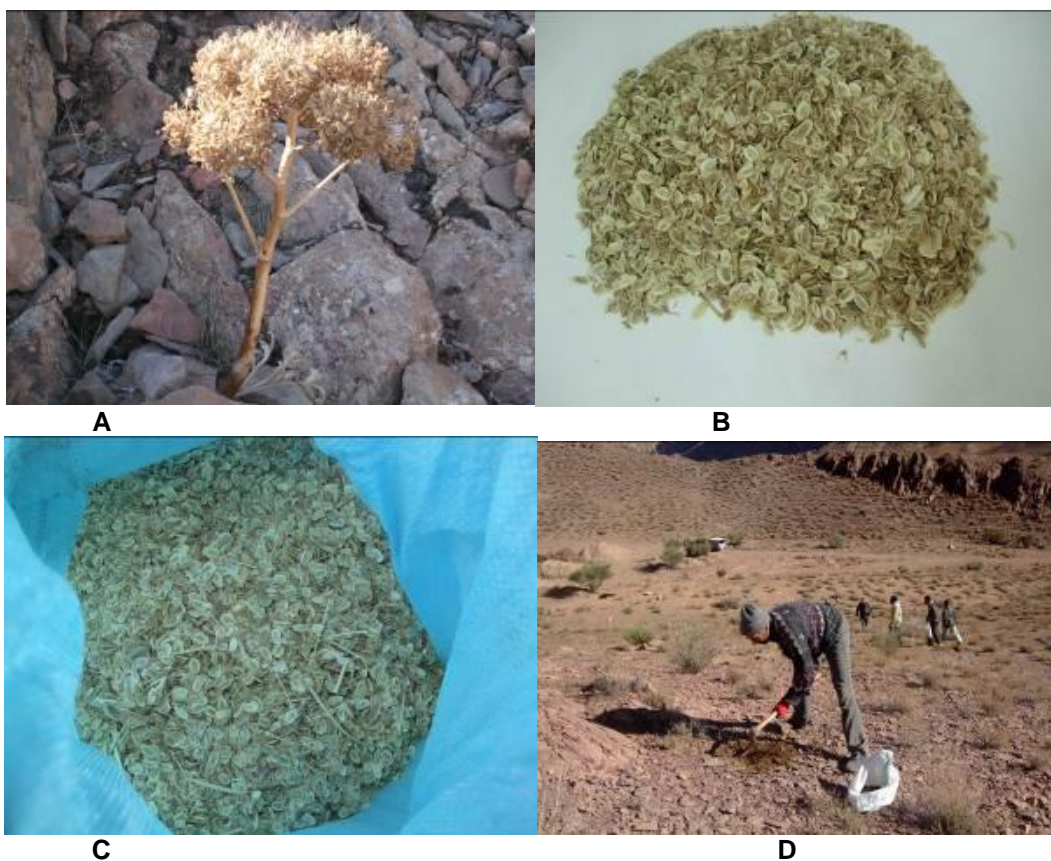


Figures 15 & 16 & 17 & 18 & 19 & 20 & 21 & 22: villagers that do various stages in preparing shrubs of *Ferula assa* and cutting its stem for harvesting and catching its medicinal gum (Shireh). Mavdar and Sorond villages of Tabas City, 300 km. distance to Birjand, centre of South Khorasan province (May 23, 2016 & 2013).

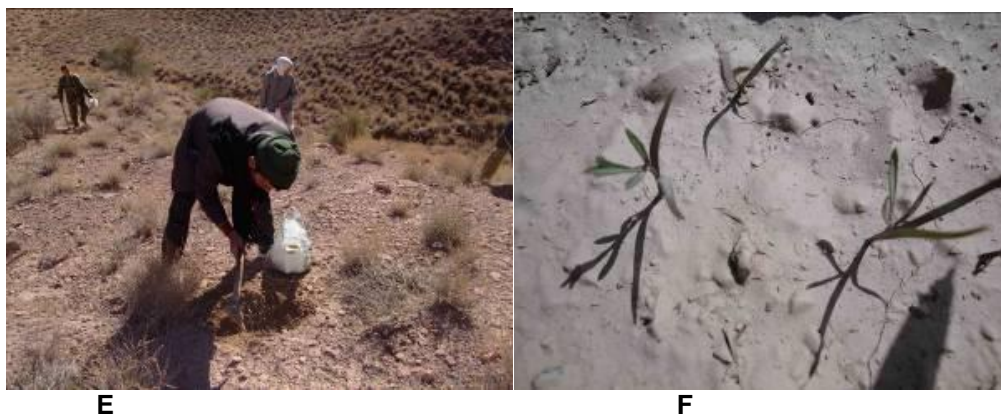




Figures 23 & 24 & 25: traditional tools of villagers for doing various stages in preparing shrubs of *Ferula assa* and cutting its stem for harvesting and catching its medicinal gum. Mavdar and Sorond villages of Tabas City, 300 km distance to Birjand, centre of South Khorasan province (May 23, 2016).







**Figures 26 & 27 & 28 & 29 & 30 & 31: Shrubs of *Ferula assa Foetida* that ready for producing seeds (figure A) and its seeds (figures B & C) and rural people that sowing its seeds in end of winter (figures D & E) and a new germinated shrub of plant in winter (figure F) in south Khorasan province (by author, 2012 & 2013).**



**Figures 32 & 33 & 34 & 35: final production of dried thin cutting stems of *Ferula assa* (Keshteh- in endemic Persian language) for supplying to market and processing by medicinal factories. Mavdar and Sorond villages of Tabas City, 300 km. distance to Birjand, centre of South Khorasan province (May 23, 2016).**

### 3. Essential oil of *Ferula*

Essential oil (volatile oils) are aromatic oily liquids obtained from plant materials such as flowers, herbs, buds, fruits, twigs, bark, seeds, wood, roots, resin, gum and latex. Essential oil components are chemically derived from terpenes and their oxygenated derivatives, which are aromatic and aliphatic acid, esters and phenolic compounds. The percentage of the components of the essential oils varies among species and plants parts which indicated that depending on the species, climate, and altitude, time of collection and growth stage. the composition of essential oils might be differed qualitatively and quantitatively.

*Ferula assa-foetida* is a medicinal plant in the Apiaceae family. The plant is an herbaceous perennial with an unpleasant odour and is often considered to be the main source of oleo-gum-resin (OGR, a milky exudates from certain plants that coagulates on exposure to air) which has a characteristic sulfurous odour and bitter taste (Kavoosi and Rowshan, 2013).

Oleo-gum resin is obtained as secretions of the upper parts of the roots of the plants by incision. It is dark brown to black resin-like gum obtained from the juice of the rhizome. After drying, it becomes darker brown, resin-like mass. Different grades of resins, dried granules, chunks, or powders are sold. It is marketed in three forms-tears, mass, and paste (figures 36 & 37).



**Figures 36 & 37: Essential medicinal oil – oleo gum resin (OGR) - of *Ferula assa-foetida* (Shireh- in endemic Persian language) in jelly (first) and solid (final) formats. obtained from pastures of Mavdar and Sorond villages of Tabas City, 300 km. distance to Birjand, centre of South Khorasan province (May 23, 2016).**

Chemical composition and antibacterial activity of essential oils from commonly consumed herbs, such as *Citrus aurantium*, *C. limon*, *Lavandula angustifolia*, *Matricaria chamomilla*, *Mentha piperita*, *M. spica*, *Ocimum basilicum*, *Origanum vulgare*, *Thymus vulgaris*, *Salvia officinalis* and *Zataria multiflora* and their main components have been evaluated in many countries.

The main constituent of OGR is essential oil which contains ferulic acid, sesquiterpene, sulfur-containing compounds, monoterpenes and other volatile terpenoids.

Although advances in chemical and pharmacological evaluation of *F. assa-foetida* have occurred in the recent past, however several useful feature of this plant have been remained unknown (Kavoosi and Rowshan, 2013).

Accordingly, essential oils obtained from *F. assafoetida* OGRs in different collections had different chemical composition, antioxidant, ROS, RNS, H<sub>2</sub>O<sub>2</sub> and TBARS scavenging. The essential oil from OGR1 was constituted high levels of acyclic sulfur-containing compounds [(E)-1-propenyl sec-butyl disulfide and (Z)-1-propenyl secbutyl disulfide] and bicyclic sesquiterpenes [10-epi-c-eudesmol] and showed the highest radical scavenging and the lowest antibacterial and antifungal activities. Essential oil from OGR2 was constituted high levels of acyclic sulfur-containing compounds [(Z)-1- propenyl sec-butyl disulfide and (E)-1-propenyl sec-butyl disulfide] and bicyclic monoterpenes [b-pinene and a-pinene] and showed moderate radical scavenging, antibacterial and antifungal activities. Essential oil from OGR3 was constituted high levels of bicyclic monoterpenes [b-pinene and a-pinene] and heterocyclic disulfide [1,2-dithiolane] and showed the lowest radical scavenging and the highest antibacterial and antifungal activities. For that reason, the essential oil obtained from the earlier stages of *F. assafoetida* growth could be used as safe and effective natural antioxidants

in food industry to improve the oxidative stability of fatty foods during storage while, the essential oil obtained from the later stages of *F. assa-foetida* growth could be used in health industry as a safe and effective source of antimicrobial agents. However, this is the first report on the effect of growth stage on the essential oil profile in *F. assa-foetida*. More professional study required to examined phenolic and flavonoid biosynthetic pathway and expression profile of the related enzymes. With these expertise study we can talk with assurance about tentative applications of essential oils (Kavoosi and Rowshan, 2013).

#### **4. *Ferula* and traditional medicine**

In traditional medicine the plant is used for the treatment of different diseases, such as asthma, epilepsy, stomachache, flatulence, intestinal parasites, weak digestion and influenza (Kavoosi and Rowshan, 2013).

*Ferula assa-foetida* L. belongs to the Apiaceae (Umbelliferae) family of plants and its oleo gum resin is known as asafoetida and people of some countries still consume it as a spice and medicinal herb

The old traditional phytomedicine asafoetida, an oleo-gum-resin obtained from the roots of different *Ferula assa-foetida*, is used in different countries for various purposes. Asafoetida is not only used as a culinary spice but also traditionally used to treat various diseases, including asthma, gastrointestinal disorders, intestinal parasites, etc.

This oleo-gum-resin has been known to possess antifungal, anti-diabetic, anti-inflammatory, anti-mutagenic and antiviral activities. A wide range of chemical compounds including sugars, sesquiterpene coumarins and polysulfides have been isolated from this plant. Recent studies have shown new promising antiviral sesquiterpene coumarins from this old phytomedicine.

Asafoetida is an oleo-gum-resin obtained from the exudates of the roots of the Iranian endemic medicinal plant, *Ferula assa-foetida*. This species (*Ferula assa-foetida*) is often considered to be the main source of asafoetida, although other *Ferula* species, such as *Ferula foetida*, *Ferula rubricaulis*, *Ferula rigidula*, *Ferula alliacea* and *Ferula narthex*, are also sources of asafoetida.

*Ferula assa-foetida* grows wild in the central and southern mountains of Iran. The oleo-gum-resin asafoetida is called "Anghouzeh", "Khorakoma" and "Anguzakoma" in Iran.

The plant, which belongs to the Apiaceae family, is an herbaceous perennial with an unpleasant odor that grows to about 2m in height. The oleo-gum-resin is often obtained by incision of the roots or removal of the stems. Hardened exudates (oleo-gumresin) are then collected and packed for export.

Asafoetida occurs in two principle forms, tears and mass. Mass is the most common form of asafoetida in the market. Asafoetida has been used as a spice and a folk phytomedicine for centuries. Asafoetida has a characteristic sulfurous odor and a bitter taste. It is used as a flavoring spice in a variety of foods, particularly in India. In addition, Nepali people regularly consume it in their daily diets, and it is believed that asafoetida has aphrodisiac, sedative and diuretic properties.

It is traditionally used for the treatment of different diseases, such as asthma, epilepsy, stomachache, flatulence, intestinal parasites, weak digestion and influenza.

Asafoetida consists of three main fractions, including resin (40–64%), gum (25%) and essential oil (10–17%).

The resin fraction contains ferulic acid and its esters, coumarins, sesquiterpene coumarins and other terpenoids.

The gum includes glucose, galactose, l-arabinose, rhamnose, glucuronic acid, polysaccharides and glycoproteins, and the volatile fraction contains sulfur-containing compounds, monoterpenes and other volatile terpenoids.

Bioassay-guided fractionation studies of asafoetida have led to the identification of some interesting bioactive compounds; for example, Lee et al. characterized antiviral sesquiterpene coumarins from asafoetida that are more potent than amantadine against influenza A.

In Iranian folk medicine, asafoetida is also used as a medicine for the treatment of asthma. It seems that the most frequent uses of asafoetida are in upper respiratory diseases, including the treatment of asthma, bronchitis and whooping cough (as an expectorant), and gastrointestinal disorders as an anthelmintic, anti-flatulence and antispasmodic.

Although asafoetida has been reported to be obtained from different sources, *Ferula assa-foetida* is considered to be the main source of asafoetida. This plant is native to central Asia, particularly eastern Iran and Afghanistan, from where it is exported to the rest of the world.

Although asafoetida is not native to India, it has been used in Indian medicine and cookery for ages. In addition, it has been used in traditional medicine of other countries such as Malaysia, Nepal and Fiji.

New pharmacological studies have almost confirmed the traditional uses of asafoetida as an anthelmintic, antispasmodic and antibacterial agent. In addition, there is a correlation between some traditional uses of asafoetida and those of new studies. For example, modern phytochemical and pharmacological studies have been revealed that umbelliprenin is one of the major components of asafoetida possessing strong lipoxygenase inhibitory activity.

Another biological activity of asafoetida, which has been confirmed by a number of new studies, is cancer chemoprevention.

Anthelmintic property (or anthelmintic) is another emphatically reported traditional use of asafoetida in different countries.

In Iran, China and Nepal, it is traditionally used for infestation with intestinal parasites. (Iranshahy and Iranshahi, 2011) & (Gundamaraju, 2013).

According to the Chinese, European, Iranian and Indian traditional medicines, oleo gum resin of *Ferula assa-foetida* (*asafoetida*) has therapeutic effects on different kinds of diseases. Some of these effects are related to the diseases of nervous system such as hysteresis and convulsion (Moghadam et al., 2014) (Figures 38- 46).







**Figures 38 & 39 & 40 & 41 & 42 & 43 & 44 & 45 & 46 & 47: scientific tour & field trip of author in medical plant of *Ferula assa Foetida* with research team from Botanical Garden belonged to ministries of education and science of the Republic of Kazakhstan in visiting from historical market of Birjand and its traditional shops of medicinal plants plus visiting pastures and mountains around Mavdar and Sorond villages of Tabas City, 300 km. distance to Birjand, centre of South Khorasan province (May 22 & 23, 2016) (Golmohammadi, 2016).**

#### **5. situation of exploitation pastures of *Ferula* in the South khorasan province**

Pastures are the most valuable national resources for each country which its proper utilization and basic management can provide an essential role in soil and water conservation, in addition to meeting the country needs for protein.

Disproportion between the number of exploiters and thus the number of livestock units that feed on the pasture forage provide the grounds for the major problems including retrogression of pastures, reduction of the value pasture species, proliferation of invader species, soil erosion and totally destruction the environment.

The different methods of range management including long-term exploitation, short-term exploitation and under grazing indicate the effects of grazing pressure on the reduction of vegetation and palatable species with forbs in the grazed pastures and by removing the factor of livestock grazing, the percent of vegetation and litter increases in the short and long-term. The exploitation also leads to increase the soil conservation and decrease the bare soil surface in the pasture (Tajali and Khazaeipool, 2012).

In this regard, in South khorasan province as a most deprived and dried region of Iran, we see all of the above problems plus high periods of drought and overgrazing of herds specially cattles of goats and sheep (Information and Statistical Department, 2016) (Figures 47 - 55).











**Figures 48 & 49 & 50 & 51 & 52 & 53 & 54 & 55 & 56: author presence in pastures and ranges of *Ferula assa Foetida* (major weak) with herds of sheep and goats (specially). Mavdar and Sorond villages of Tabas City, 300 km. distance to Birjand, centre of South Khorasan province (May 23, 2016).**

#### **6. Other important pasture medicinal plants in South Khorasan province**

There are some other important pasture medicinal plants in South Khorasan province that local people traditionally collect and use them. during thousands of years accumulated a huge amount of indigenous and local knowledge about these medicinal plants which are important elements in traditional herbal and medicinal system of these native people. Nowadays we can observe this indigenous and local knowledge among native people from high rate of reception and going to meet from traditional shops of medicinal plants among various categories of society in South Khorasan province.

We can note for example to followings medicinal plants: ash tree, Pomegranate, Apricot, Black cherry, borage, *althaea officinalis*, *portulca olaraceae*, *tribulus terrstrhs*, *achillea eriophoradc*, *alhagi-persarumboiss*, *descurahnha sofia.*, *portulca olaraceae*, *tribulus terrstrhs*, *onobrychis aucheri boiss*, *peganum harmala*, *malva neglecta wallr*, common mallow, *cynodon dactylon L pers*, *crataegus turkestanica*, *Eremurus luteus Baker*, *cuscuta sp*, *Polygonum aviculare L.*, *Artemisia dracunculus L.*, *Allium porrum*, *Rumex chaalepensis miller*, *Tamarix serotina Juglans regeal*, *Nigella sativa L.*, and etc. (Information and Statistical Department, 2016). (figures 56 - 86).











Figures 57 - 87: some endemic medicinal plants during scientific tour & field trip of author in Ferula assa Foetida with research team from Botanical Garden belonged to ministries of education and science of the Republic of Kazakhstan in visiting from historical market of Birjand and its traditional shops of medicinal plants plus visiting pastures, mountains and gardens around Mavdar and Sorond villages of Tabas City, 300 km. distance to Birjand, centre of South Khorasan province (May 22 & 23, 2016) (Golmohammadi, 2016) & Achieve (Information and Statistical Department, 2016).

## 7. Conclusions

Water is a major natural resource which is limiting factor in the development of agriculture and natural resources especially in a dried region such as Iran. Therefore, it is necessary to adopt water management technologies for utilizing the available water resources. Water is the most precious commodity in the arid region of Iran due to prevalence of unfavorable hydro meteorological condition (Golmohammadi, 2012).

We are living in a knowledge driven world where knowledge is the ultimate power (Kumari, 2014). In this regard, indigenous and local knowledge about medicinal plants are important elements of herbal and medicinal system. These resources are usually regarded as part of the cultural traditional knowledge.

Despite all kinds of technological advances, the geographic variation is one element that is far from human control, because of different climatic conditions and edaphic factors that exist in each region. Essential oil quality and quantity in general are extremely dependent on the weather conditions; also several authors considered that the physic chemical characteristics are determinant factors in secondary metabolites composition especially for quality of volatiles. So these could be explanations for the differences which are found in essential oils of the same species such as the high chemical variability of the essential oils (Moghaddam and Farhadi, 2015).

Although the flora of Persia is thus fairly well known, there are still very few works on the overall its vegetation. With approximately six thousand recorded species of ferns and flowering plants, Persia harbors one of the richest floras of the Near Eastern countries, which is surprising, given that more than two-thirds of the country's surface consists of deserts, semi deserts, and steppes. This varied geo botanical landscape reflects the great contrasts of climate within the country and the evolution of the flora. Many plant genera evolved or diversified primarily on Persian territory, particularly in the mountain regions; examples of such indigenous include taxa of *Astragalus*,

*Acantholimon*, *Acanthophyllum*, *Nepeta*, *Onosma*, and *Cousinia*. The flora and vegetation of Persia are also enriched by remnants of floras that were once far more widespread.

The demand for medicinal plants has increased globally due to the resurgence of interest in and acceptance of herbal medicine. Most of the demand is being met through collection of large quantities of medicinal plants and plant parts from wild populations. The methods of extraction employed are almost invariably crude and unsystematic. As a consequence, the rates of exploitation may exceed those of local natural regeneration. Also, the natural habitats are quickly being depleted. There is thus an urgent need to develop and implement conservation strategies for exploited medicinal plant species. The medicinal plant is propagated through seeds. However, its natural populations are very limited in native habitats, which may be due to poor seed germination. Low seed germination in Apiaceae is known (Moghadam et al., 2014) & (Golmohammadi, 2012).

Utilizing from pastures as renewable natural resources has been attended from thousands years ago by human kind. Available plants in these pastures are valuable from several aspects. Some of these plants plus their ecological value also have high economic value. Medicinal plants that available in these pastures because of their natural products have special value and have been utilizing directly (their main and principal products) or indirectly (their secondary products especially by industrial medicinal factories). In this regard *Ferula assa-foetida* L. (Apiaceae) is one most important and valuable medicinal plants in pastures of Iran and especially south-khorasan province that major of its products (about 99%) export to foreign countries (especially for utilizing by industrial medicinal factories in developed countries). Because of above reasons, main goals of managers of Natural Resources and Watershed Administration of south Khorasan province are sustainable exploitation plus maximum economical efficiency from this plant.

Also *Ferula* is one of the most important endangered medicinal plants, which is rare in nature due to poor seed germination (Information and Statistical Department, 2016).

The seed of many medicinal plant species are dormant and do not germinate unless specific environmental signals or events occur. Most production of this valuable plant, produce in south-khorasan province in extent of 100000 ha, that produce 60 tons (in rainy years) and 15-20 tons (in dried years) annually and almost all of this production export to abroad because of lack of processing industries in this province. this plant generates incomes for many rural and nomadic households, that in the conditions of their subsistence agriculture, have high dependence to this production.

One of the main problems preventing sustainable use of medicinal plants native to arid lands is that they can germinate within the native environment, but fail to show good germination under laboratory conditions or when cultivation is attempted. Seed germination is an important event in the life of *Ferula assa Foetida*. Seed dormancy is a common phase of the *Ferula assa Foetida* plant life cycle, and several parts of this seed can contribute to dormancy.

south khorasan province in east of Iran has good ethno botanical potential for medicinal plants. This study is one of the first contributions to the ethno botany of this region with emphasizing to *Ferula assa Foetida*.

With attending to above mentioned cases, author state following recommendations for sustainable management and exploitation with increasing economical efficiency of this plant:

- Utilizing from *Ferula assa-foetida* in present traditional form namely cutting its stem from above of its root for producing gum is not a sustainable way for exploiting because of after one season producing gum by mature plant, in next year *Ferula* will die. In this regard in research canthers of Natural Resources and Watershed organization of Iran, researches have been found methods for sustainable utilizing of *Ferula* such as concave and staircase methods. These new, scientific and sustainable methods must be extended among farmers (especially by agriculture and natural resources extension workers) and replacing to present prevailing hazardous traditional method.

- reducing number of small livestock (especially goats and sheep herds) and big livestock (cow's herds in second order) in major weak pastures of south khorasan province. Also preventing from grazing of these livestock herds especially in germination and exploitation seasons of *Ferula*. In this regard Natural Resources and Watershed organization of Iran must allow livestock grazing in these pastures only after the last exploitation stage of *Ferula*.

- Development strategic planning for exploitation of *Ferula* in forward to achieving appropriate utilizing from available potentials in field of *Ferula* and other medicinal plants in south khorasan province.

- Controlling on exploitation stages and Monitoring on quantity and quality of *Ferula* products.

- Conserving and restoring to life of germinating locals and pastures of *Ferula* in south khorasan province.

- Absorbing participation of local people on implementing *Ferula* plans and projects of Natural Resources and Watershed organization of south khorasan province by strengthening their local organizations of medicinal plant collectors that are usually poor villagers.

- Establishing factories in field of medicinal plants especially for *Ferula* in the south khorasan province. This can plus providing job creating for unemployed youth local people, preventing from raw and cheap selling and exporting of *Ferula* gum and increasing its final achieving value. This also is an important step for accessing to sustainable development and poverty alleviation goals and criteria in this deprived, dried and remote region of Iran.

### Acknowledgement

Author of this article is very thankful and grateful from Mr. Seyyed Esmaeel Ghoreyshi –staff member and Management Expert (Master of Science in Geology, Rangeland and Watershed) in Natural Resources and Watershed Administration of Tabas city in south Khorasan province, east of Iran. Because of his very valuable efforts and helps in gathering information, pictures and doing scientific tour and field work of this study with research team from Botanical Garden belonged to ministries of education and science of the Republic of Kazakhstan in visiting from pastures, mountains and gardens around Sorond village of Tabas City, 300 km. distance to Birjand, centre of South Khorasan province in May 23, 2016.

Author of this article is also very thankful and grateful from Mr. Fereydoon ramazani, faculty member of Department of psychology, Payam Noor University- Iran.

Also author of this article is very thankful and grateful from my dear and honorable supervisor namely Dr. Alireza Hassani - Dean of the Islamic Azad University – Birjand Branch – Birjand – IRAN – and also my dear and honorable friend namely Dr. Mohammadjavad Seghatoleslami -Vice chancellor in Planning and the Knowledge-based Economy in Birjand branch, Islamic Azad University, Birjand, Iran, and Associate professor of Agronomy, College of Agriculture, Islamic Azad University, Birjand branch, Birjand, Iran - because of their great and valuable co-working with our research team.

Also author of this article is very thankful and grateful from local people in Mavdar and Sorond villages of Tabas City, 300 km. distance to Birjand, centre of South Khorasan province (May 23, 2016) because of their great and valuable co-working and hospitality with our research team.

### REFERENCES

- Golmohammadi F. (2012) Sustainable agriculture and rural development in Iran, Some modern issues in sustainable agriculture and rural development in Iran Germany, LAP LAMBERT Academic Publishing GmbH & Co. KG.
- Golmohammadi F. (2013) Medical plant of *Ferula assa-foetida* and its cultivating, main characteristics and economical importance in South khorasan province - east of Iran. Technical Journal of Engineering and Applied Sciences 3:2334-2346
- Golmohammadi F. (2016) Certification for scientific collaboration and scientific field participation in Medical plant of *Ferula assa Foetida*- with research team from: General Director, Mangyshlak Experimental, Botanical Garden, Candidate of Biology Science, Akzhunis Imanbayeva, Aktau, Kazakhstan. Belonged to Ministries of Education and science of the Republic of Kazakhstan.
- Gundamaraju R. (2013) Evaluation of anti-helmintic activity of *Ferula foetida* "Hing- A natural Indian spice" aqueous extract. Asian Pac J Trop Dis 3:189-191.
- Hamayun M., Khan M.A., Begum S. (2003) Marketing of medicinal plants of Utror-Gabral Valleys, Swat, Pakistan. Ethnobotanical Leaflets <http://www.siu.edu/~ebl/>.
- HASSANI S.B., SABOORA A., RADJABIAN T., FALLAH HUSSEINI H. (2009) EFFECTS OF TEMPERATURE, GA3 AND CYTOKININS ON BREAKING SEED DORMANCY OF *FERULA ASSA-FOETIDA*. Iranian Journal of Science & Technology, Transaction 33:41-59.
- Information and Statistical Department. (2016) Annually Reports of Natural Resources and Watershed Organization of South Khorasan province, Iran.
- Iranshahy M., Iranshahi M. (2011) Traditional uses, phytochemistry and pharmacology of asafoetida (*Ferula assa-foetida* oleo-gum-resin)—A review. Journal of Ethnopharmacology 134:1-10.
- Kavoosi G., Rowshan V. (2013) Chemical composition, antioxidant and antimicrobial activities of essential oil obtained from *Ferula assa-foetida* oleo-gum-resin: Effect of collection time. Food Chemistry 138:2180–2187.
- Kumari N.C., S.B. Jha, S.K. and Singh, S.R.K. (2014) Radio: An Educational Media to Transfer Agricultural Information among Farmers. Indian Res. J. Ext. Edu. 14:130-132.
- Moghadam F.H., Dehghan M., Zarepur E., Dehlavi R., Ghasemini F., Ehsani S., Mohammadzadeh G., Barzegar K. (2014) Oleo gumresin of *Ferula assa-foetida* L. ameliorates peripheral neuropathy in mice. Journal of Ethnopharmacology 154:183–189.
- Moghaddam M., Farhadi N. (2015) Influence of environmental and genetic factors on resin yield, essential oil content and chemical composition of *Ferula assa-foetida* L. populations. Journal of Applied Research on Medicinal and Aromatic Plants 2:69-76.
- Tajali A.A., Khazaeipool M. (2012) Management effects on vegetation characteristics of pastures in north of Iran. International Journal of Biosciences (IJB) 2:2222-5234.