



## Shilajit: A himalayan herbomineral wonder

Aliefia Y Lehari\*, Swati S Patil

Department of Pharmacognosy, Prin KM Kundnani College of Pharmacy, Cuffe Parade, Mumbai, Maharashtra, India

### Abstract

An unhealthy lifestyle if not appropriately managed may lead to immuno compromised conditions and chronic diseases, such as several types of cancer, diabetes mellitus, hypertension, obesity, and cardiovascular diseases. To overcome these conditions, various naturally obtained drugs may be used as supplements such as Shilajit which is known by names such as Shilajitu, Silaras, Hajar ul musa, Momi, Myemu etc. Shilajit which is mainly of plant and mineral origin is a blackish brown compound that contains humic and non humic matter. Humic acid and fulvic acid are the major biologically active compounds present in Shilajit along with trace amounts of other organic constituents such as dibenzo pyrones and triterpenoid compounds. Shilajit can be effectively used to treat various disorders and shows various therapeutic effects such as antioxidant, anti-inflammatory, anti-ulcerative, muscle strength improvement, anti-cancer, photoprotective, treatment of mountain sickness, nephroprotective, hepatoprotective, cardioprotective, learning augmentation, adaptogenic and various other therapeutic benefits. Shilajit is a relatively safe and nontoxic substance and if consumed daily as a supplement, it equips the consumer with better immunity, longevity and overall wellness.

**Keywords:** shilajit, herbomineral, adaptogen, humic compounds, fulvic acid, anti-oxidant, anti-cancer, immunomodulator

### Introduction

In today's fast-paced world excessive stress combined with poor diet, alcohol abuse and lack of exercise have paved a way for numerous disorders. An unhealthy lifestyle may lead to immuno compromised conditions and chronic diseases, such as several types of cancer, diabetes mellitus, hypertension, obesity, and cardiovascular diseases. Several researches are on-going to find a solution to tackle these health conditions. Shilajit—a blackish-brown compound of humic origin is one of the outcomes of this research. It is obtained from the Himalayan Mountains and is known to prevent and cure various lifestyle-related disorders when combined with an improved lifestyle.

Shilajit which is a blackish-brown herbomineral exudate is an integral part of traditional Indian medicine and is regarded to have therapeutic benefits by hakims and vaidyas who study its properties. This resinous substance of rocky origin is found in the mountainous regions of the Himalayas and Hindukush ranges. It has also been found in Afghanistan, Pakistan, Yemen, China, Bhutan, Mongolia, Japan, Nepal, Tajikistan, and many other regions [2].

Shilajit is known by various names in different languages, such as Shilajatu, shilaras, silajit, silaras in Sanskrit. mineral pitch, asphalt or Jews pitch in English; shilajita or shilajit in Hindi, Gujrati and Marathi; Shilajitu in Bengali; Perangyum, uerangyum, kalmatam in Tamil; Hajar-ul-musa in Arabic and Mumie in German. In Persian it is known as Momiai-faqurul-yahud and Myemu in Russian [2].

Since ancient times, Shilajit has been used to treat a plethora of disorders and to maintain overall wellness. <sup>2</sup>Current scientific studies on shilajit have shown its applications in treating a variety of lifestyle related disorders and have validated numerous claims made about the efficacy of this herbomineral drug.

### Origins and Historical Significance

It has been claimed that Shilajit exuding from a layer of rocks of mountains is basically of vegetative origin in the ancient writings of the Sushruta Samhita, it is mentioned that during the summer months owing to the increased temperatures the sap or latex of plants emerge as a sticky exudate [2].

The origin of Shilajit is still not completely known but many hypotheses have been put forth regarding it. It has however been studied that Shilajit is mainly composed of humus – the characteristic constituents of soil –together with other organic constituents. Plants such as *Euphorbia royleana* Boiss and *Trifolium Repens* which bear latex and occur in the vicinity of the Shilajit bearing rocks are thought to be the most likely source of Shilajit. Some studies claim that certain bryophytes were responsible for Shilajit formation. Presence of Liverworts like *Asterella*, *Marchantia*, *Pellia*, *Dumortiera* and *Plagiochasma* as well as moss species such *Minium*, *Thuidium*, *Barbula*, *Stephenrencella* *Anthoceroswre* and *Fissidenc* was noted in the vicinity of Shilajit-exuding rocks. Minerals such copper, silver, zinc, iron, lead etc, were found to be present in the tissues of these bryophytes which are similar to the elements present in Shilajit [2].

There has been a significant amount of folklore that has been recorded in regard to the discovery of Shilajit following which human consumption of Shilajit began. Observing a particular species of white monkeys who were found migrating during early summer towards the mountain slopes is what led to this discovery. Villagers observed the monkeys licking the exudate from rocks and they may have concluded that this resinous exudate imparted strength, wisdom, and possibly promoted longevity. Subsequently, they began to consume the resin and found that it left them feeling energetic and also provided them with enhanced memory, better digestive, and sexual health.

Shilajit has been widely recognized and used since times immemorial throughout the world. In ancient Egypt, Shilajit was commonly employed during mummification. It was also used to counteract poisons by Greeks. It is a vital component in the daily diet of the people of Tajikistan. A Chinese compendium belonging to the 15th century mentions the therapeutic benefits of fulvic acid [2]. Shilajit is beneficial not just to humans and animals but also to plants as it can be used to promote seed germination and plays a role in improving plant growth [2, 3].

Shilajit is collected at high altitudes ranging from 1000 to 5000 meters. However, slight variations in physicochemical and to an extent, physiological properties are seen among samples collected from different geographical regions [4].

In the Ayurvedic, Unani and Siddha system of medicine, Shilajit has been used for a variety of ailments such as wound healing, muscle and tendon related injuries, treating bone fractures, as an anti-inflammatory specially to treat arthritis. It has also been used for its anti-ulcerative properties. Shilajit was also used to treat impotence, disorders of the nervous and cardiovascular system. Owing to its antimicrobial activity it has been used to treat infections such as those of the urinary tract. Further clinical studies based have made use of human and animal studies to prove the veracity of the diverse therapeutic claims of Shilajit [5].

#### Varieties of Shilajit

According to ancient texts such as the Charaka Samhita, there are two distinct types of Shilajit, A semi-hard, brownish resin that is greasy to touch and possesses a distinct coniferous odour and bitter taste (gomuthira Shilajit) and the other being a white variety with a camphor like odour called karpura Shilajit.

Further classification of the former leads to four main subtypes of Shilajit. each of which possess different properties and are hence used to treat different disorders.

These four varieties are: Gold ore Shilajit (Savarna), silver ore Shilajit (Rajat), copper ore shilajit (Tamra) and iron ore Shilajit (Lauha) which is believed to be the most beneficial form and is predominantly found in the Himalayas [2].

Shilajit also differs in its constituents depending on the geographical source. Commonly used varieties include Indian, Mongolian and Yemeni Shilajit. <sup>6</sup> Other popular varieties are commonly sourced from Afganistan, Balochistan (Pakistan), Tibet and Russia to name a few.

#### Physicochemical Properties and Molecular Composition

Samples of Shilajit collected from different geographical sources show a definite similarity in their physical properties. In terms of appearance, purified shilajit has a shiny, polished surface and is sticky to touch. Shilajit shows solubility in solvents such as water, acetone and alcohol. Raw shilajit shows up to 60% solubility in water [2].

The pH of Shilajit is approximately between 6-8 and differs in value depending on its source. Shilajit also shows slight variations in its chemical composition depending on various factors such as geographical source and environmental factors such as temperature, humidity, altitude, presence of moulds, fungi and plants etc [7].

Chemical constituents present in Shilajit mainly include humic matter, inorganic compounds benzoic and hippuric acid as well as their salt forms, gums, albuminoids and trace quantities of resin. Of these constituents, the major active

compounds are fulvic acid, humic acid and benzoic acid (benzoates) [5]. Other organic constituents in Shilajit mainly include pyrone compounds such as oxygenated dibenzo alpha pyrones, terpenoid compounds (tirucallane terpenoids), phenol group containing lipids, saponins and tannins. These major compounds are used for standardization of Shilajit [7].

Humic matter accounts for upto 70% of the water-soluble fraction. Shilajit also contains metabolites of plant and microbial origin in trace quantities [8].

Shilajit can be considered a bituminous resin consisting of animal and plant origin constituents. Low molecular non humic constituents are generally characterized easily through methods such as spectroscopy in contrast to humic compounds which do not specifically exhibit characteristic physical and chemical properties. Shilajit contains compounds such as acuparins derived from phenyl propanoid compounds, dibenzo pyrones, E and Z isomers of triterpenoid sapogenins biphenylcarboxylate compounds and their derivatives. One of the major humic compounds, fulvic acid possesses a flexible structure that is rather open and shows presence of several micropores. Fulvic acid samples from bioequivalent samples show similarities in their inorganic mineral composition, absorbance ratio, viscosity, spectroscopy etc [9].

#### Uses of Shilajit

Shilajit can be used to treat a plethora of disorders and is hence considered a natural holistic medicinal agent. Ancient Indian scriptures mention the use of Shilajit in the treatment of anaemia, respiratory disorders such as bronchitis, genitourinary infections, nervous system disorders digestive disorders, it is usually given along with milk to treat diabetes. Shilajit has also been utilised as a potent aphrodisiac

#### Various Therapeutic Properties of Shilajit Include Improvement of Muscle Strength

Studies have indicated the ability of purified Shilajit compounds in increasing the levels of adenosine tri phosphate in mice owing to improved mitochondrial function [10].

Shilajit also brings about connective tissue integrity and boosts collagen formation thus preventing or reducing the possibility of occurrence of bone, tendon or muscle related degenerative disorders and improving overall muscular strength [10].

#### Antioxidant and Anti-Inflammatory Activity

Shilajit exhibits potent antioxidant activity which was determined using DPPH scavenging method and the reducing power assay technique where scavenging percent of two extracts of SHilajit namely water and DMSO extract were increased in small increments to reach a value of 50% at concentrations of 2500 µg/mL for water extract and 6000 µg/mL for the DMSO extract [11].

In an *in vitro* study conducted, it was demonstrated that Shilajit is effective against acute, sub acute and chronic inflammation and also showed a slightly better anti inflammatory effect when compared with the NSAID diclofenac sodium. The extent of the activity depends mainly on the dose administered [11].

The antioxidant activity of Shilajit can be attributed to its inhibition of lipid peroxidation and it's free radical

scavenging activity<sup>[12]</sup>. The anti-inflammatory properties of Shilajit also contribute to wound healing. Shilajit has also been used to hasten the recovery from burn wounds possibly by increasing oxygen supply to the wounded area<sup>[13]</sup>.

### **Cancer Chemoprotective and Cytotoxic Activity**

Shilajit acts as a chemoprotective agent against different types of cancers. It has been known to exhibit antioxidant activity against NO and OH radicals due to presence of dibenzo-alpha-pyrones and fulvic acid which mainly contribute to its chemoprotective action. Studies have revealed a decreased rate of oxidation of reduced glutathione content and lipid peroxidation inhibition due to Shilajit. Shilajit also exhibits anti-mutagenic, heavy metal chelating properties and also in decreasing solubility of heavy metal compounds.

HA has been shown to inhibit mutagenesis in yeast which were exposed to 4-nitroquinoline-N-oxide. HA has been known to actively absorb polycyclic aromatic hydro-carbons which are major carcinogens. Furthermore, it can also inactivate 2, 4, 6-Trichlorophenol which is responsible for various cancers such as lymphomas, leukemia and liver cancer in animals. The bioavailability of toxins and mutagens is reduced due to HA thus reducing the damaging effects of these substances on the body<sup>[8]</sup>.

Cell lines of MCF-7 and A549 were used to study the cytotoxicity potential of Shilajit using an MTT assay for which the (IC<sub>50</sub>) values were found to be 727.5±1.9 µg/mL and 1103±3.2 µg/mL in the case of MCF-7 and A549, respectively for the water extract and the values for DMSO extract were found to be 2363.4±3.8 µg/mL and 2020.8±1.7 µg/mL on the cell line of MCF-7 and A549, respectively<sup>[11]</sup>.

### **Anti-Ulcerogenic Activity**

Studies conducted on Shilajit have concluded its restorative effects on gastric ulcers due to presence of certain polyphenolic components such as fulvic acids, benzoic acid, and tri terpenoids, which have been attributed to cause a decrease in secretion of acid and pepsin while also decreasing the rate of cell shedding and lowering of the gastric ulcer index. The major restorative effects of Shilajit include increasing secretion of mucin and improving the carbohydrate to protein ratio. Fulvic acid is effective in treatment of not only gastric ulcers but also related disorders such as gastritis and colitis. An orally administered dose of 100mg/kg effectively lowered ulcer index value in ulcers induced by immobilization and aspirin. The incidence of cysteamine induced duodenal ulcers in rats and histamine induced ulcers in guinea pigs was found to be lowered following pretreatment with Shilajit<sup>[12]</sup>.

### **Efficacy in Overcoming high Altitude Problems**

Shilajit improves muscle strength and prevents muscle and bone degradation. It effectively treats tiredness, lethargy and other problems that mainly occur at higher altitudes. Fulvic acid improves bioavailability of minerals such as iron thus improving blood formation. Due to its detoxifying and blood oxygen percentage enhancing properties, Shilajit helps prevent occurrence of hypoxic conditions thus making it an efficient antidote for carbon dioxide poisoning and other conditions such as acute mountain sickness which commonly occurs in hilly regions. Other conditions such as high altitude cerebral edema which causes swelling of brain tissues owing to lowered atmospheric pressure are also

effectively tackled using Shilajit as it exerts a diuretic effect thus maintaining extracellular volume and aids in removal of excess fluid and toxins<sup>[14]</sup>.

### **Photoprotective Action**

Harmful solar radiations such as UV<sup>?</sup> may cause a variety of skin related problems that generally include sunburn, skin cancer and related conditions. Shilajit acts as a photoprotective agent and thus can be safely used for protection of the skin from UV radiation<sup>[14]</sup>.

### **Immunomodulatory and Adaptogenic Activity**

Activation of macrophages and splenocytes has been noted following treatment with shilajit which acts as an adaptogen and thus helps adapt to different environments<sup>[14]</sup>.

### **Antiallergic Activity**

A pronounced anti allergic effect is seen with Shilajit treatment against histamine releasers. Mast cell degranulation can also be induced by Shilajit thus validating its use as an anti allergic drug<sup>[14]</sup>.

### **Bioenhancement Properties**

Shilajit has been known to enhance bioavailability of other drugs in the body. Due to its high mineral content it provides the body with essential minerals. Fulvic acid which is one of the major active constituents of Shilajit helps transport nutrients into tissues and also aids in removal of toxins<sup>[14]</sup>.

### **Learning Augmentation and management of certain psychological disorders**

Dementia is caused due to neuronal degradation occurring due to prevalence of hypoxic conditions or presence of free radicals in the brain. Shilajit acts as an immunostimulant and is hence effective in the treatment of immune and nervous disorders. Studies conducted have mentioned its use in treatment of anxiety<sup>[14]</sup>.

### **Antidiabetic Activity**

Reduced activation and migration of lymphocytes and macrophages was observed following treatment with Shilajit thus contributing to its role as an immunomodulator. Induced damage to the islets of Langerhans by oxygen radicals can be possibly prevented by the use of Shilajit.

A dose of (100 mg/kg) of Shilajit produced hypoglycemia in rats with normal blood glucose levels. It has been studied that a pancreatrophic action leading to improved sensitivity and better insulin production rates could be produced with long term Shilajit treatment.

When combined with antihyperglycemic drugs such as glibenclamide, shilajit causes a significant lowering of blood glucose levels as compared to either drug administered singly. This indicates that shilajit may possess extrapancreatic action that produces hypoglycemia. The combination of shilajit with glibenclamide does not however improve the lipid profile.

When compared with other antidiabetic agents such as metformin(500mg/kg), hypoglycemia produced by a 100mg/kg administered dose of Shilajit is significantly higher. However, the combination did not cause a lowering of blood sugar levels greater than that produced by shilajit alone. However, the combination does improve the overall lipid profile excluding effects on triglyceride levels.

In alloxan induced diabetic rats, it was noted that Shilajit improved the overall lipid profile and helped in the management of hyperlipidemia which could be attributed to improper metabolism of glucose, fat and protein. The antihyperlipidemic action of Shilajit was found to be better as compared to its antihyperglycemic action.

In euglycemic rats, it was observed that Shilajit significantly improved the lipid profile by lowering levels of TG and TCh while increasing levels of HDL thus providing a better secondary control on hyperglycemia by acting on lipid metabolism<sup>[15]</sup>.

### Reproductive and Hormonal Actions

The rate of daily sperm production was found to increase following treatment with shilajit as compared to rats exposed to cadmium damage and has also restored spermatogenesis by increasing germ cell layers and reducing the number of affected seminiferous tubules. The effect observed was found to be dose dependent. An increase in serum testosterone levels was also observed with shilajit treatment. It was found that parameters such as sperm motility and sperm count in the cauda epididymis showed a significant improvement due to administered doses of Shilajit. The improvement was further enhanced by increasing the dose administered<sup>[16]</sup>.

### Cardioprotective Potential

When rats pretreated with Shilajit were exposed to isoproterenol induced myocardial damage a significant cardioprotective action was observed as it minimised its damaging effect to heart tissue and cardiac performance. Short term consumption of Shilajit or mumie for one week did not have a significant effect on blood pressure and dp/dt max which serve as important cardiovascular parameters although the negative effects of isoproterenol on parameters such as max dp/dt (index of contractility) and min dp/dt (index of relaxation velocity) was prevented by pretreatment with Shilajit in a way that there were no significant differences when compared to control groups. Shilajit treatment resulted in lowering of serum levels of cTnI (troponin) which increases due to myocardial damage and also resulted in minimising myocardial lesions in groups treated with mumie and subsequently exposed to ISO. Ischemia is induced by ISO exposure and results in increased serum troponin levels and also reduces contractility and relaxation velocity thus increasing ventricular end diastolic pressure thus leading to formation of lesions. ISO also increases the oxygen demand and workload on the heart which could lead to hypoxia. This damage is decreased by Shilajit treatment which improves the blood's oxygen carrying capacity thus providing sufficient oxygen during hypoxic conditions. Shilajit also reduces leukocyte infiltration and congestion in damaged hearts while also inhibiting histamine release and mast cell degranulation due to its anti inflammatory action. The antioxidant effect of Shilajit was however found to be not likely involved in its cardioprotective activity<sup>[17]</sup>.

### Anti-Retroviral and Antimicrobial Activity

Shilajit has been known to prevent initiation of viral infection and is also capable of limiting the ongoing infection (*in vitro*). An inhibitory activity against viruses such as HSV1, HSV2, HCMV AND RSV was seen in a

dose dependent manner. Shilajit however does not have an effect on cell viability even at high concentrations upto 1500µg/ml. This indicates that cytotoxicity did not result in its antiviral action. Shilajit demonstrates antiviral action against three viruses HSV-1, HSV-2 AND HCMV of the Herpesviridae family and one virus belonging to Paramyxoviridae family but does not affect VSV (Rhabdoviridae) and rotavirus (Reoviridae) thus indicating its narrow and specific spectrum of activity. The mode of action is believed to occur during early replication stages where Shilajit may prevent entry of the virus into cells or prevent viral attachment to cell surfaces by interacting with the virus particles and not the cell components. Irreversible inactivation of viral particles may also contribute to its antiviral action<sup>[8]</sup>.

Shilajit possesses antimicrobial activity against both gram positive and gram negative bacteria. An intermediate zone of inhibition was seen with both types. The zone of inhibition was maximum for two Gram positive organisms namely *S.pneumonia* and *B.subtilis* (20mm). Smaller zones of inhibition were seen for other gram positive bacteria such as *S.aureus* (17mm) and *S.saprophyticus*. The maximum value for zone of inhibition in gram negative bacteria was shown by *Shigella dysenteriae* and *S.paratyphi A* (17mm each) followed by *E.coli*, *P.fluorescence* and *Klebsiella oxytoca* (16mm). Smaller values were obtained for *S.typhi* (14mm) and *Citrobacter* (13mm). Shilajit also exhibits a potent antifungal activity against organism such as *C.albicans* (50mm)<sup>[18]</sup>.

### Nephroprotective Activity

It has been shown that aqueous extracts of Shilajit show significant nephroprotective activity against cis platin induced nephrotoxicity in rats. A histopathological examination revealed that the rats treated with Shilajit (Shilajit+cisplatin) show a decrease in the extent of necrosis, tubular dilatation and casts in the tubules when compared to the cisplatin induced nephrotoxic rats thus proving the nephroprotective potential of Shilajit<sup>[19]</sup>.

### Improvement Following brain Injury

Traumatic brain injury is usually accompanied with edema and a significant rise in intracranial pressure which can be improved upon by administration of Shilajit. It has been noted that Shilajit successfully lowered intracranial pressure and blood water content. Due to its anti inflammatory and related effects, Shilajit also decreases blood brain barrier permeability and decrease oxidative stress thus preventing further neurological damage<sup>[20]</sup>.

### Hepatoprotective Action

Shilajit has proven to be effective in treatment of non alcoholic fatty liver disease that causes liver damage. It was noted that a decrease in parameters such as weight, AST and ALT, triglyceride levels, TC, Low density lipoproteins, glucose levels and abnormal lipid retention (steatosis). Furthermore an increase in high density lipoproteins was observed. Shilajit also improved the overall histopathology of liver tissue and restored the antioxidant balance<sup>[21]</sup>.

### Conclusion

Natural medicinal agents such as Shilajit can prove to be a boon in treatment of various disorders as well as lifestyle management. Shilajit, a versatile ancient therapeutic gem

has shown a significant effect in treatment and management of various diseases such as cancer, diabetes, kidney ailments, heart diseases, arthritis and other conditions most of which are lifestyle induced and are invariably linked.

Though Shilajit may require combination with conventional drugs in treatment of certain disorders, its efficacy and importance cannot be undermined. Shilajit is a relatively safe and nontoxic substance and if consumed daily as a supplement, it equips the consumer with better immunity, longevity and overall wellness.

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