

REVIEW ARTICLE

Shilajit: A Review

Suraj P. Agarwal, Rajesh Khanna^{1*}, Ritesh Karmarkar, Md. Khalid Anwer and Roop K. Khar

Department of Pharmaceutics, Jamia Hamdard (Hamdard University), Hamdard Nagar, New Delhi 110062, India

¹Present address: Dabur Research Foundation, 22, Site IV, Sahibabad, Ghaziabad, Uttar Pradesh – 201010, India

Shilajit is a pale-brown to blackish-brown exudation, of variable consistency, exuding from layers of rocks in many mountain ranges of the world, especially the Himalayas and Hindukush ranges of the Indian subcontinent. It has been found to consist of a complex mixture of organic humic substances and plant and microbial metabolites occurring in the rock rhizospheres of its natural habitat. Shilajit has been used as a rejuvenator and an adaptogen for thousands of years, in one form or another, as part of traditional systems of medicine in a number of countries. Many therapeutic properties have been ascribed to it, a number of which have been verified by modern scientific evaluation. Shilajit has been attributed with many miraculous healing properties.
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INTRODUCTION

Shilajit, also known as salajit, shilajatu, mumie or mummiyo is a pale-brown to blackish-brown exudation, of variable consistency, from layers of rocks in many mountain ranges of the world, especially the Himalayan ranges of the Indian subcontinent (Kong *et al.*, 1987; Srivastava *et al.*, 1988) (Fig. 1). It is also found in Russia, Tibet, Norway and other countries, where it is collected in small quantities from steep rock faces at altitudes between 1000 and 5000 m. Shilajit samples from different region of the world, however, vary in their physiological properties.

Shilajit, an ancient traditional medicine has been ascribed a number of pharmacological activities and has been used for ages as a rejuvenator and for treating a number of disease conditions (Acharya *et al.*, 1988). Modern scientific research has systematically validated a number of properties of shilajit and has proven that shilajit is truly a panacea in Oriental medicine (Chopra *et al.*, 1958; Ghosal, 1993). Since there are a number of such remedies described in our ancient texts, it is imperative that research is carried out in order to validate their claims and uses.

Traditional medicine is an integral part of the health care system in a number of developing countries including India. There are a number of natural remedies, which have been in use for ages in Asian countries but unfortunately lack systematic scientific evaluation and documentation. The world today is looking at these remedies for a number of ailments. However, these remedies can only find a place for themselves in the



Figure 1. Rock shilajit in its raw form.

mainstream medicine if their claims are evaluated scientifically and documented systematically.

Shilajit is one such remedy, which has been in use as a folk medicine for over 3000 years as a rejuvenator and adaptogen (Sharma, 1978). It has been used by Vaidyas and Hakims for ages and has a unique place in the ancient texts. It has been said that there is hardly any curable disease that cannot be controlled or cured with the aid of shilajit. Although this is a tall order, scientific studies over the past 20–25 years have shown that it is indeed a panacea in traditional medicine, effective in a number of ailments. This is a brief review of the ancient claims for this panacea and the modern scientific findings that have validated these claims.

Shilajit mainly consists of paleohumus (around 80–85%) and organic compounds derived from vegetation fossils that have been compressed under layers of rocks for hundreds of years and have undergone a high amount of metamorphosis due to the high temperature and pressure conditions prevalent there (Ghosal *et al.*, 1991a; Ghosal *et al.*, 1997; Ghosal *et al.*, 1993b).

During warm summer months, shilajit become less viscous and flows out between the layers of rocks.

* Correspondence to: Rajesh Khanna, Dabur Research Foundation, 22, Site IV, Sahibabad, Ghaziabad, Uttar Pradesh – 201010, India.

E-mail: khannar@dabur.com

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SHILAJIT IN ANCIENT TEXTS

Shilajit has been used for thousands of years, in one form or another, under the indigenous systems of medicine such as Ayurveda, Siddha and Unani. It is bitter in taste and its smell resembles pungent cow's stale urine (Ghosal, 1994; Ghosal *et al.*, 1995e). It has various synonyms. In Sanskrit, it is called Silajit or Silaras, adrija, girija (all meaning derived from rock). In English, it is called asphalt, mineral pitch or Jews pitch. In Hindi, Gujarati and Marathi, it is called Silajita, Shilajit. In Bengali, it is called Silajatu. In Arabic, it is called Hajar-ul-musa. It is also called, Momio in Persian, myemu in Russian and mumie in German (Chopra *et al.*, 1958; Ghosal, 1993; Ghosal *et al.*, 2000). The Sanskrit meaning of shilajit is 'Conqueror of mountain and destroyer of weakness'. There are several other terms for shilajit such as dathuras, dathusara, shiladhatu, etc have been used in ancient medical texts. The word dhatu was used as a synonym of shilajit simply to emphasize its capability as rasayana, which increases the activity of the saphadhatu of the body (Tewari *et al.*, 1973).

VARIETIES OF SHILAJIT

There are four different varieties of shilajit which have been described in charka samhita, namely savrana, rajat, tamra and lauha shilajit. Savrana shilajit is gold shilajit and is red in colour. Tamra is a copper shilajit and is blue in colour. Rajat is a silver shilajit and is white in colour while the lauha shilajit is an iron-containing shilajit and is brownish-black in colour. Tamra and savrana shilajit are not found commonly but the last variety, i.e. lauha shilajit is commonly found in Himalayan ranges and is supposed to be most effective according to the therapeutic point of view (Ghosal *et al.*, 1995b, 1995c; Sharma, 1978; Chopra *et al.*, 1958).

ORIGIN OF SHILAJIT

There are many scientists who claim that shilajit exuding from a layer of rocks of mountains is basically of vegetative origin (Chopra *et al.*, 1958; Shakir *et al.*, 1965). Ancient texts of Sushruta samhita and rasarangini also focus on these points. It has been mentioned in Sushruta samhita that in the month of May–June the sap or latex juice of plant emerges as a gummy exudation from the rocks of mountains due to the strong heat of the sun, and Rasarangini and Dwarishtarang also claim that shilajit is an exudation of latex gum resin, etc. of plants which comes from rocks of mountains under the presence of harsh scorching heat. But exact scientific proof on the origin of shilajit remains incomplete.

There are a number of hypotheses about the origin of shilajit (Joshi *et al.*, 1994). Early scientific work carried out on shilajit showed that it is mainly composed of humus – the characteristic constituents of soil – together with other organic constituents. Latex bearing plants, namely *Euphorbia royleana* Boiss and *Trifolium repens* which occur in the vicinity of the shilajit bearing rocks are thought to be the most likely source of shilajit

(Ghosal *et al.*, 1976; Ghosal *et al.*, 1988b). Other recent research claims that the mosses of species such as *Barbula*, *Fissidenc*, *Minium*, *Thuidium* and species of Liverworts like *Asterella*, *Dumortiera*, *Marchantia*, *Pellia*, *Plagiochasma* and *Stephenrencella-Anthoceros* were present in the vicinity of shilajit-exuding rocks and these bryophytes are responsible for the formation of shilajit (Joshi *et al.*, 1994). The bryophytes reveal the occurrence of minerals and metals in their tissues such as copper, silver, zinc, iron, lead etc, which are similar to the elements present in shilajit.

CHEMICAL CONSTITUENTS

Extensive research has been carried out to determine the exact chemical nature of shilajit. Earlier work on shilajit showed that its major organic constituents included benzoic acid, hippuric acid, fatty acids, resin and waxy materials, gums, albuminoids and vegetable matter with benzoic acid being the active ingredient (Kong *et al.*, 1987; Ghosal *et al.*, 1976). Extensive research in the 1980s showed that the major organic mass of shilajit comprised humus (60–80%) along with other components such as benzoic acid, hippuric acid, fatty acid, ichthyol, ellagic acid, resin, triterpenes, sterol, aromatic carboxylic acid, 3,4-benzocoumarins, amino acids and phenolic lipids (Ghosal *et al.*, 1988b). The major physiological action of shilajit was found to be due to the presence of the bioactive dibenzo-alpha-pyrones along with humic and fulvic acids which acted as carrier molecules for the active ingredients (Ghosal, 1990; Ghosal, 1980).

The composition of shilajit is influenced by factors such as the plant-species involved, the geological nature of the rock, local temperature profiles, humidity and altitude, etc. For example, it was found that shilajit obtained from India in the region of Kumoan contains a higher percentage of fulvic acids (21.4%) compared with shilajit obtained from Nepal (15.4%), Pakistan (15.5%) and Russia (19.0%). On the other hand, the bioactive low molecular compound is found in high quantities in shilajit obtained from Nepal. Similarly the pH of 1% aqueous solutions varied in the shilajit obtained from different countries, namely, 6.2 for India (Kumoan), 7.5 for Nepal (Dolpa), 6.8 for Pakistan (Peshawar) and 8.2 for Russia (Tien-Shan). Similarly, humic constituents in shilajit samples obtained from these countries also varied (Ghosal *et al.*, 1991b).

PURIFICATION AND FORMULATION OF SHILAJIT

Modern research has shown that shilajit in its natural form is often contaminated by varying amounts of impurities such as mycotoxins, heavy metal ions, polymeric quinones, reactive free radicals, etc. Mycotoxins are produced by mold or fungi and can cause illness or death in man. Free radicals can be harmful to cells and are believed to be a causative factor in aging. Polymeric quinones are an oxidation product of quinic acid which is found in some plants. Hence, it is necessary to purify the shilajit before it is consumed. The findings

are consistent with the ancient texts which recommend the purification of shilajit before consumption (Ghosal *et al.*, 1996).

USES OF SHILAJIT IN TRADITIONAL MEDICINE

Shilajit has an important and unique place in traditional texts such as Ayurveda Siddha and Unani medicine. Shilajit is prescribed to treat genitourinary disorder, jaundice, gallstone, digestive disorders, enlarged spleen, epilepsy, nervous disorder, chronic bronchitis, anemia.

Shilajit is given along with milk to treat diabetes. Shilajit has also been ascribed a potent aphrodisiac property. According to Ayurveda, shilajit arrests the process of aging and produces rejuvenation which are two important aspects of an Ayurvedic rasayana (Ghosal, 1990).

Shilajit is useful for treating kidney stones, oedema, piles, internal antiseptic, adiposity, to reduce fat and anorexia. Shilajit is prescribed along with guggul to treat fractures. It is believed that it goes to the joints and forms a callus quickly. The same combination is also used to treat osteoarthritis and spondylitis.

Shilajit is also used as yogavaha (Ghosal *et al.*, 1991b; Ghosal *et al.*, 1995c) (yogavaha is an agent which enhances the property of other drugs). Shilajit is soaked in the decoction of one or more of the following plants as this is said to increase their efficacy: *Shoria robusta* (sala), *Bachanania lactifolia* (piala), *Acacia farnesiana* (acacia), *Terminalia tomentosa* (asana), *Catechu nigrum* (catechu), *Terminalia chebula* (myrobelan) and *Sida cordifolia* (bala). Work has recently been initiated to further investigate this property of shilajit (Khanna, 2005).

PRECLINICAL RESEARCH ON THE ACTIVITY OF SHILAJIT

Antiulcerogenic and antiinflammatory activity

Studies were carried out on shilajit samples collected from different locations to evaluate their possible role as antiulcerogenic and antiinflammatory agents. It was found that shilajit increased the carbohydrate/protein ratio and decreased the gastric ulcer index, indicating an increased mucus barrier (Ghosal *et al.*, 1988a). Shilajit was also found to have potent antiinflammatory activity in all three models of acute, subacute and chronic inflammation. Shilajit, at a dose of 50 mg/kg was also found to significantly reduce carrageenan-induced hind paw oedema in rats, having an effect comparable to phenylbutazone (100 mg/kg, i.p.) and betamethasone (0.25 mg/kg, i.p.) (Goel *et al.*, 1990).

Shilajit is perhaps the first agent to possess both antiulcerogenic and antiinflammatory activities and this unique property of shilajit can be safely utilized in clinical practice.

Antioxidant activity

The antioxidant property of processed shilajit was compared with unprocessed shilajit and vitamin C

(ascorbic acid). Processed shilajit exhibited significant antioxidant activity of itself and also had the ability to regenerate (recycle) ascorbic acid after it had neutralized free radicals. The dihydroxybenzo-alpha-pyrones in shilajit caused recycling (regeneration) of ascorbic acid. Unprocessed shilajit did not consistently exhibit the antioxidant activity.

In another experiment, processed shilajit was tested for its ability to neutralize sulphite anion, hydroxy and nitric oxide free radicals. Chemical polymerization by free radicals was measured with and without processed shilajit. Processed shilajit provided almost complete protection of methyl methacrylate against hydroxyl radical-induced polymerization and significantly inhibited the polymerization of methylmethacrylate by the sulphite free radical. Processed shilajit efficiently trapped nitric oxide free radicals. The antioxidant effects were concentration dependent. Higher concentrations of processed shilajit provided greater free radical protection (Ghosal *et al.*, 1995b; Bhattacharya *et al.*, 1995).

In a separate experiment, the effect of shilajit on lipid peroxidation and glutathione content in rat liver homogenates was also investigated. It was found that shilajit inhibited lipid peroxidation induced by cumene hydroperoxide and ADP/Fe⁺⁺ complex in a dose dependent manner (Ghosal, 2000). Shilajit also decreased the rate of oxidation of reduced glutathione content and inhibited the ongoing lipid peroxidation which was induced by these agents immediately after its addition to the incubation system (Tripathi *et al.*, 1996).

Learning augmentation

The study was carried out to test the validity of use of shilajit as an Ayurvedic medha rasayana (enhancer of memory and learning) in albino rats. Processed shilajit, native shilajit and a preparation consisting of a mixture of ethyl acetate extractive and fulvic acids obtained from processed shilajit were evaluated in an active avoidance, elevated plus-maze and open field behavior paradigms. It was found that processed shilajit and its active constituents (total ethyl acetate fraction and fulvic acids) significantly increased the learning acquisition and memory retention in old albino rats (Ghosal *et al.*, 1993a). However, shilajit native produced an erratic response (both augmentive and retardative) in the above parameters.

Antidiabetic activity

Diabetes mellitus was produced in male albino rats by the administration of streptozotocin (STZ) 45 mg/kg s.c. on two consecutive days. Hyperglycemia along with superoxide dismutase activity of pancreatic islet cells was assessed on days 7, 14, 21 and 28 following STZ administration. In two separate other groups, shilajit at a dose of 50 and 100 mg/kg, p.o. was administered concurrently from 28 days. It was found that STZ induced significant hyperglycemia by day 14, which was further increased progressively on days 21 and 28. Similarly STZ also induced a decrease in pancreatic islet cell superoxide dismutase activity which was apparent on day 7 and increased progressively, thereafter on days 14, 21 and 28. Shilajit at a dose of 50 and

100 mg/kg, p.o. had no dispersible *per se* effect on the blood glucose level in normal rats but attenuated the hyperglycemic response of STZ from day 14 onwards, though only the effect of the higher dose was statistically significantly. Similarly, both doses, i.e. 50 and 100 mg/kg p.o., of shilajit reduced the STZ-induced decrease in superoxide dismutase activity from day 14 onwards, the effect of lower dose being statistically insignificant. An earlier observation that STZ-induced hyperglycemia may be due to a decrease in pancreatic islet superoxide dismutase activity, leading to an accumulation of free radicals and damage of beta cells has been confirmed by these experiments. Shilajit prevents both effects of STZ possibly by its action as a free radical scavenger. This experiment supports the earlier writing of Ayurveda that shilajit can prevent maturity onset diabetes mellitus (Bhattacharya, 1995).

Memory enhancement and anxiolytic activity

The effect of shilajit was investigated for putative nanotropic and anxiolytic activity in Charles Foster strain albino rats. The nanotropic activity was assessed by passive avoidance learning acquisition and retention while the anxiolytic activity was studied and evaluated by the elevated plus-maze technique. The results of these studies indicated that shilajit had significant nanotropic and anxiolytic activities. The biochemical studies carried out for the level of monoamines indicated that acute treatment with shilajit had an insignificant effect on rat brain monoamines and monoamine metabolite levels. However, it was observed that sub-acute (5 days) dose treatment caused a decrease in 5-hydroxy indole acetic acid concentration and an increase in the level of dopamine, homovallanic acid and 3,4-dihydroxyphenyl acetic acid concentration with an insignificant effect on noradrenaline and 3-methoxy-4-hydroxyphenylethylene glycol levels. The observed neurochemical studies on shilajit indicate a decrease in rat brain 5-hydroxytryptamine turnover, associated with an increase in dopaminergic activity leading to an increase in memory and anxiolytic activity in albino rats (Jaiswal and Bhattacharya, 1992).

Antistress activity

Shilajit collected from India, Nepal, Pakistan and Russia and organic constituents isolated from them were studied for their antistress effect in albino mice. It was found that shilajit from Kumoan (India), Dolpa (Nepal) and a combination of the total ethyl acetate extract and fulvic acids extracted from Kumoan shilajit produced a statistically significant improvement in forced swimming induced immobility in albino mice (Ghosal *et al.*, 1991b).

Antiallergic activity

The effect of shilajit and its main active constituents fulvic acids, 4'-methoxy-6-carbomethoxybiphenyl and 3,8-dihydroxy-dibenzo-alpha-pyrone were studied in relation to the degranulation and disruption of mast cell against noxious stimuli. Shilajit and its active constituents provided satisfactory significant protection to

antigen-induced degranulation of sensitized mast cells, markedly inhibited the antigen induced spasm of sensitized guinea-pig ileum and prevented mast cell disruption (Ghosal *et al.*, 1989). These findings are consistent with the therapeutic use of shilajit in the treatment of allergic disorders.

Immunomodulatory activity

Shilajit as an immunomodulator agent was studied in mice that were given either shilajit extract or a placebo. The white blood cell activity was studied and monitored prior to and at intervals after receiving the shilajit extract or a placebo. It was found that the white blood cell activity was increased by shilajit extract. The observed activity increased as the dose of shilajit extract and time of exposure was increased (Bhaumik *et al.*, 1993). Shilajit and its combined constituents elicited and activated, to different degrees, murine peritoneal macrophages and activated splenocytes of tumor-bearing animals at early and later stages of tumor growth.

In another experiment, the effect of shilajit was determined on the levels of brain monoamines in rats. It was found that shilajit at a dose of 25 and 50 mg/kg i.p. for 5 days significantly reduced the level of 5-hydroxy tryptamine and 5-hydroxy indole acetic acid and increased the level of dopamine, noradrenaline and their metabolites in rat brain. These changes in neurotransmitter levels are similar to those seen in cases of increased humoral (immune) activity and hence validate its use as an ayurvedic rasayana (Ghosal, 1990).

Anti AIDS activity

Shilajit is endowed with both immunopotentiating (Ghosal, 1990, 1992a, 1992b, Ghosal, 1998; Ghosal *et al.*, 1995a, 1995d; Bhaumik *et al.*, 1993) and viral load reducing properties (Ghosal, 2000; 2002a). Clinical studies in AIDS patients with a multi-component natural product-formulation, comprising three essential and three supportive ingredients, in which shilajit was one of the essential constituents was conducted. Of the 36 patients enrolled, 22 who received the treatment with the formulation for 6 months showed positive signs of improvement. Their CD4 and CD8 cell counts were increased from 259 ± 119 (CD4) and 733 ± 483 (CD8) to 356 ± 203 and 984 ± 356 , respectively. Ten patients who received the treatment for 1 year, showed a distinct improvement in the symptoms and augmentation in the CD4, 516 ± 272 ; CD8 1157 ± 428 cell counts (Ghosal, 2006).

PATENTS ON SHILAJIT

Extensive research has been carried out on shilajit to justify its claims. A research study on shilajit bioactive constituents proved that they have healing, antiaging and restorative properties. The following is a list of patents so far filed on shilajit: US Patent No. 5,405,613 – vitamin/mineral composition (Rowland, 1995); US Patent application No. 20030198695 – Herbo-mineral composition (Ghosal, 2002a); US Patent No. 6,440,436

– Process for preparing purified shilajit composition from native Shilajit (Ghosal, 2002b); US Patent No. 6,558,712 – Delivery system for pharmaceutical, nutritional and cosmetic ingredients (Ghosal, 2003).

CONCLUSION

Shilajit is a humus rich blackish-brown substance, which is very useful in many diseases and serves as a potent tonic. It is perhaps the best rasayana Ayurveda has prescribed. Although these and many other claims of

shilajit had been mentioned in ancient texts, they lacked scientific validation. Modern research has validated these claims and has proven shilajit to be a panacea in oriental medicine. Since there are a number of traditional medicines available with varied claims regarding their therapeutic activity, it is necessary that research be undertaken based on modern scientific methods possibly leading to more panaceas in traditional medicine.

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