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THE ARCHIVE · EVIDENCE REVIEW · MONOGRAPH

Shilajit: mechanism & *evidence*

A structure–function review of the Altai resin and its active fractions — fulvic acid, dibenzo-α-pyrones, and the humic substances that carry them. What the human literature supports, what remains preclinical, and where the honest limits are.

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ABSTRACT

Shilajit is a humic-substance–rich resin that seeps from high-altitude rock, its bioactivity concentrated in a small set of fractions: fulvic acid, dibenzo-α-pyrones, and the larger humic acids that act as carriers. The mechanistic case — chelation, membrane transport, redox buffering, and mitochondrial support — is coherent and reproducible in vitro and in animal models. The human case is narrower: two small randomized trials support an endocrine effect over ~90 days and a connective-tissue/strength effect over ~8 weeks, atop a broader base of reviews and preclinical work. This review reads the evidence at face value, states the effect windows plainly, and treats purity as inseparable from efficacy.

01 · PROVENANCE & COMPOSITION

What shilajit *is*

Shilajit is not a plant, a mineral, or a fungus — it is a humic exudate: the slow product of plant and microbial matter compressed and transformed in rock over centuries, seeping from cracks at altitude as a blackish-brown resin. ASCENTIALS sources from the Altai range above 3,000 metres, where the cold and the fulvic-to-humic ratio favour a cleaner, more standardizable material.

By mass, most of shilajit is humic substances and trace minerals. But mass is the wrong lens. The activity concentrates in a small fraction: the low-molecular-weight fulvic acid, the aromatic dibenzo-α-pyrones, and their derivatives.[1] A resin's quality is therefore measured by its standardized fulvic percentage and its assay for contaminants — not by the length of the mineral list on a label.

02 · THE ACTIVE FRACTIONS

Three things doing the *work*

Fulvic acid. The principal active fraction. Of the three humic substances — fulvic acid, humic acid, and humin — fulvic acid has the lowest molecular weight (under ~1 kDa) and the highest oxygen

content, which is precisely why it is biologically interesting: small enough to cross cell membranes, reactive enough to carry other molecules with it.[1]

Dibenzo-α-pyrones (DBPs). Small aromatic molecules that travel with the fulvic fraction and are studied as electron carriers with a role in mitochondrial energy transfer. In the review literature, DBPs and fulvic acid are named together as the constituents most responsible for shilajit's reported effects.[1]

Humic acid. The larger, less-mobile sibling of fulvic acid. It contributes to the carrier behaviour of the whole complex — humic and fulvic acids together have been described as vehicles that can enhance intestinal absorption of the compounds they bind.[5]

03 · MECHANISMS OF ACTION

How it plausibly *works*

Four mechanisms recur across the literature. None is a claim of cure; each is a structure–function description of what the molecules do.

— **Chelation.** Fulvic acid binds mineral ions into small, ring-shaped complexes. This can make wanted minerals more absorbable, or help escort unwanted metals out.[6]

— **Membrane transport.** Low molecular weight lets fulvic acid shuttle its bound cargo across the intestinal wall and into cells — the step that follows chelation.[5]

— **Redox buffering.** Fulvic acid both donates and accepts electrons, which is thought to support mitochondrial electron transport and blunt oxidative stress.[1]

— **Mitochondrial support.** In isolated mitochondria and in animal fatigue models, standardized shilajit attenuates ATP depletion — the bioenergetic thread that connects the fatigue and performance findings.[5]

> A NOTE ON MECHANISM VS. PROOF
>
> A coherent mechanism is a reason to run the trial, not a substitute for it. The sections below separate what has been shown in people from what remains, for now, mechanistic or preclinical.

04 · THE HUMAN EVIDENCE

What has been shown in *people*

The controlled human literature on shilajit is small but real. Two randomized, placebo-controlled trials anchor it, both using purified material at doses in the 250–500 mg/day range.

2	250–500 mg	90 days	8 weeks
SMALL HUMAN RCTS	DAILY DOSES STUDIED	ENDOCRINE WINDOW	COLLAGEN / STRENGTH

Endocrine — testosterone in healthy men

In a randomized, double-blind, placebo-controlled trial, healthy men aged 45–55 took 250 mg of purified shilajit twice daily for 90 consecutive days. The treatment group showed significant increases in **total and free testosterone** and DHEAS relative to placebo, while the gonadotropins LH and FSH were maintained — a pattern consistent with support rather than override of the endocrine axis.[2] The effect is real in this population and this window; it is not instant, and it has not been replicated at scale.

Connective tissue — strength retention & collagen

In a double-blind, placebo-controlled trial of 63 physically active men, 8 weeks of standardized shilajit at **500 mg/day** (but not 250 mg/day) significantly lowered serum **hydroxyproline** — a marker of collagen degradation — and helped preserve maximal strength after a fatiguing protocol.[3] The dose-dependence is worth stating honestly: the lower dose did not reach significance.

01 **Pandit S, et al. · Andrologia · 2016** RCT
250 mg ×2/day, 90 days, men 45–55 — significant rise in total/free testosterone & DHEAS vs. placebo; LH/FSH maintained.

02 **Keller JL, et al. · J Int Soc Sports Nutr · 2019** RCT
500 mg/day, 8 weeks — decreased serum hydroxyproline and retained maximal strength after fatigue; 250 mg/day did not.

03 **Stohs SJ · Phytother Res · 2014** REVIEW
Safety/efficacy review — adaptogenic, antioxidant, anti-inflammatory signals; explicitly notes few well-controlled human studies.

05 · PRECLINICAL & MECHANISTIC EVIDENCE

Promising, but not yet *human*

A larger body of work is preclinical or in vitro. It is where the mechanism is strongest and the caveats are heaviest — animal and cell findings do not transfer automatically to people.

Mitochondrial bioenergetics & fatigue

In a rat model of chronic fatigue, standardized shilajit modulated the hypothalamic–pituitary–adrenal (HPA) stress axis and improved mitochondrial bioenergetics, attenuating the ATP collapse seen under repeated forced-swim stress.[5] This is the animal correlate of the human strength/fatigue signal — a plausible bridge, not a proof in people.

Cognition — fulvic acid and tau

A review of shilajit's procognitive potential highlights in-vitro evidence that fulvic acid acts as an **anti-aggregation factor for tau protein**, alongside antioxidant and anti-inflammatory activity.[4] This is an early, mechanistic finding of research interest — not a basis for any claim about cognitive disease, and we make none.

06 · SAFETY, PURITY & HEAVY METALS

Why purity *is* the efficacy story

Shilajit's origin is also its liability. Because it forms in rock, raw resin can concentrate **lead, arsenic, mercury, and aluminium** from the surrounding geology, and unprocessed material may additionally carry mycotoxins and fungal contamination. This is not a fringe concern — it is the central quality question for the category.

The safety literature is consistent on the resolution: **properly purified** shilajit, dosed sensibly, carries an acceptable heavy-metal profile.[1] The mechanism by which fulvic acid binds metals — chelation — is the same chemistry that makes contamination screening non-negotiable.[6] Independent testing across the market has repeatedly shown variability between products labelled "purified," which is why a claim is not a substitute for a batch assay.

ASCENTIALS' answer is procedural, not rhetorical: cold-extracted Altai resin, standardized to ≥60% fulvic acid, with a per-batch Certificate of Analysis confirming identity, standardization, and freedom from heavy metals by ICP-MS. Purity is not a marketing tier here; it is the precondition for every effect described above.

07 · DOSAGE & EFFECT WINDOWS

Honest *timelines*

The studied doses cluster at 250–500 mg/day of standardized resin. The effects are not immediate, and the review is explicit about stating that plainly:

— **Endocrine (testosterone/DHEAS)** — measured over a **~90-day** course at 500 mg/day total (250 mg twice daily).[2]

— **Connective tissue / strength retention** — measured over **~8 weeks** at 500 mg/day; the 250 mg arm did not reach significance.[3]

— **Energy / fatigue** — mechanistically supported and reported in reviews, but the strongest bioenergetic data remain preclinical.[5]

The practical reading: shilajit is a **gradual** agent. Expectations set on a 90-day curve are honest; expectations set on a single dose are not.

08 · LIMITATIONS & OPEN QUESTIONS

What we don't yet *know*

— **Small samples, few replications.** The two anchoring RCTs are modest in size and, as of this review, not widely replicated. The category's own safety review notes how few well-controlled human studies exist.[1]

— **Population narrowness.** The endocrine trial studied men 45–55; extrapolation beyond that group is unproven.[2]

— **Mechanism-to-outcome gaps.** The mitochondrial and cognitive findings are compelling mechanistically but sit at the preclinical/in-vitro level.[4,5]

— **Product heterogeneity.** Because activity and safety both track with purification and standardization, results from one standardized material may not generalize to another. Read the Certificate of Analysis, not the marketing.

09 · REFERENCES

Sources, in *full*

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05 **Surapaneni DK, et al. · J Ethnopharmacol · 2012** PRECLINICAL
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06 **Flora SJS, Pachauri V · Int J Environ Res Public Health · 2010** REVIEW
Chelation in metal intoxication. Int J Environ Res Public Health 7(7):2745–2788.
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cites it in full; entries are informational, describe mechanisms rather than outcomes, and are not medical advice. Effect timelines are stated honestly — many are gradual, and preclinical findings are labelled as such.

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